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Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

ALBION REED HODGDON, Editor-in-Chief

ALBERT FREDERICK HILL
STUART KIMBALL HARRIS
RALPH CARLETON BEAN
ROBERT CRICHTON FOSTER
ROLLA MILTON TRYON
RADCLIFFE BARNES PIKE
} Associate Editors

VOLUME 64

1962

The New England Botanical Club, Inc.

Botanical Museum, Oxford St., Cambridge 38, Mass.

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Vol. 64 January-March, 1962 No. 757

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CHANGE OF EDITOR-IN-CHIEF

Since the founding of Rhodora in 1899, there have been but three principal editors. B. L. Robinson started the journal and was Editor-in-Chief for thirty years. M. L. Fernald succeeded Robinson in 1929 and served until his death in 1950. It might appear to some that this long period, together with the eleven years I have served in this same capacity, established a tradition that the head of the Gray Herbarium also be Editor-in-Chief of Rhodora. However, there is no inherent reason why this should be the case even though there has always been a very close association between the Gray Herbarium and the New England Botanical Club. This association has existed from the founding of the Club, and we are hopeful that it will continue undiminished far into the future.

Over the years there has been a steady expansion of the geographical area to which Rhodora pertains. At first, New England and the Maritime area of Canada were uppermost in the minds of both contributors and receivers of the journal. Later, Gray's Manual area was thought of in this connection. Now, we think in terms of the North American Flora as a frame of reference when considering manuscripts and there is only a loose adherence to this area. Expansion in a different direction has also occurred. Systematic Botany is now widely considered to include most aspects of evolutionary botany, cytotaxonomy, experimental taxonomy, cytogeography and genecology and Rhodora has regularly accepted papers that reflect this greater breadth of view of the subject.

With this issue, the journal begins as a quarterly. It is anticipated that the coverage will be roughly what it has been in recent years. Also, it is expected that the number of printed pages per volume will be aproximately 376, about the same as recent volumes. To carry the journal forward, the Council of the New England Botanical Club has named Professor Albion R. Hodgdon, Chairman of the Department of Botany, University of New Hampshire, as Editor-in-Chief. Associate Editors are listed on the front cover.

It is a pleasure for me to turn over the reins of Rhodora to Professor Hodgdon and to wish him every success in this new undertaking.

Added to my own efforts in editing Rhodora during the past eleven years have been those of a number of Club members acting in the capacity of Associate Editors. To these men, I should like to express publicly my appreciation. — REED C. ROLLINS.

CHROMOSOME NUMBERS OF DYSSODIA (COMPOSITAE-TAGETINAE) AND PHYLETIC INTERPRETATIONS

MARSHALL C. JOHNSTON AND B. L. TURNER[1]

The genera *Dyssodia* Cav., *Nicolletia* Gray, *Leucactinia* Gray, *Chrysactinia* Gray, *Porophyllum* Adans., *Lescaillea* Griseb., *Pectis* L., *Tagetes* L., and *Adenopappus* Benth. together constitute a natural group characterized by the possession of oil glands and aromatic oils, and by the arrangement of the principal phyllaries in two subequal series and often united into a cup. This group, whose naturalness has not been questioned, has on the one hand been given tribal status as the Tagetinae or Tageteae (Cassini, 1829, 1834; Rydberg, 1915) and at the other extreme has been submerged in the Heliantheae in the broader sense (Cronquist, 1955), but it has usually been included in the Helenieae[2] as the subtribe Tagetininae (Bentham, 1873; Hoffmann, 1894; etc.)

Of the genera included, *Dyssodia* in the very broad sense of Hoffmann (1894) and of this paper, is the most diverse

[1]Supported in part by National Science Foundation Grant 9025.

[2]That the tribe Helenieae is artificial (polyphyletic) has been suggested so often it scarcely bears repetition (Bentham, 1873; Small, 1919; Leonhardt, 1949; Cronquist, 1955; etc.). For suggestions as to the true affinities of certain included genera see Cronquist (1955), Turner (1956), Rock (1957), Turner and Johnston (1961), Turner, Ellison and King (1961), and Raven and Kyhos (1961) and papers cited by them.

from the standpoint of both morphology and cytology. Among its species, we find some plants which show combinations of the most specialized traits, and others which show combinations of the least specialized traits of the entire group. The ancestry of the other genera might well have comprised plants which would be placed in the genus *Dyssodia*, if they persisted today. *Dyssodia*, then, is of primary interest for an elucidation of phylogeny of the subtribe. The present paper tabulates the few chromosome counts for the genus already published along with the numerous original ones (Table 1). The counts are presented within the framework of a possible classification of the genus proposed by Rydberg (1915).

METHODS

Chromosome counts newly reported in the present paper were made from pollen mother cell squashes as outlined by Turner and Johnston (1961a). The microscopy was partly the work of Dr. W. L. Ellison and Mr. A. M. Powell, to whom we are much obliged. Camera lucida drawings were made at an initial magnification of ca. 2,000 diameters, and selected drawings are presented in Fig. 1-8. Voucher specimens (Table 1) are deposited in The University of Texas Herbarium. The determinations are our own.

OBSERVATIONS

Chromosome counts are reported for 45 populations of *Dyssodia* representing 17 species (Table 1). The gaps in our chromosomal knowledge are obvious. Most of these are due to the general unavailability of the taxa concerned. However, we may point out such a glaring omission as *D. papposa* which occurs from southern Ontario to southern Mexico, and is one of the most abundant roadside annuals in the highlands of Mexico. The deficiencies stem from the difficulty encountered in attempting to get usable bud material in this genus as compared to the ease of obtaining usable material for some other Helenieae. Upwards of 250 bud-collections of *Dyssodia* have been received, from which are derived the 45 new counts presented here. The technical difficulties may partly be related to an abundance of oil in the buds which seems to interfere with proper fixation of the nuclear

material, and partly to a propensity of the chromosomes to clump or fragment at meiosis. Perhaps a really thorough populational sampling, especially in the critical sections Thymophylla and Hymenatherum, may have to await the development of better techniques for working with meiotic chromosomes.

The section *Dyssodia*, containing the type species *D. papposa*, has a base of $x = 13$. These are plants of the Mexican highlands showing such unspecialized traits as retention of a calyculum and separate principal phyllaries. Our concept of *D. pinnata* includes *D. subintegerrima* Lag., and our concept of *D. papposa* (Johnston, 1956a) is likewise more inclusive than that of Rydberg (1915).

Syncephalantha, a Central American segregate, is obviously part of *Dyssodia* from a morphological point of view and its chromosome base of $x = 13$ supports such a treatment.

The section Clomenocoma is primarily southern Mexican and Central American, with at least two Peruvian species. The only counts reported are from two species which are anomalous in their ecogeography in that they occur in the Sonoran Desert. The base number, $x = 13$, is what one would expect when the relatively unspecialized character of the taxon is considered. It is probably that the whole section is on a base of $x = 13$.

Dyssodia porophylla and *D. cancellata*, both placed in the genus *Lebetina* by Rydberg, are morphologically very close to *Dyssodia* and also show a base of $x = 13$. They are widespread annual weeds in Mexico.

For *Dyssodia acerosa* of the section Aciphyllaea we have conflicting reports, one from the southwestern United States of $n = 12$ (Raven, *et al.*, 1961), four of our own tentative counts of $n =$ ca. 13, and one clear, unequivocal count of $n = 8$. This is a widespread desert species of southwestern United States and far south into Mexico that is fairly uniform morphologically. It may also be added that in an otherwise very difficult genus, this is one of the species we have found most difficult to work with cytologically, and that these preliminary data only serve to whet our curiosity.

Plants of the sections Gymnolaena and Adenophyllum of southern Mexico show combinations of some of the least specialized habits and involucres to be found in *Dyssodia*. It is perhaps from among these sections that we may find species most closely resembling the ancestral types for the entire genus. Unfortunately, we have no chromosomal information for either of these sections.

Dyssodia tagetoides, endemic to Texas and Oklahoma (Johnston, 1956a), and placed in the monotypic genus *Dysodiopsis* by Rydberg, remains unknown cytologically in spite of several attempts to obtain counts.

The section *Thymophylla* comprises several species of low perennial herbs and shrublets of the dry areas of Mexico, Arizona, New Mexico and western Texas, showing certain specializations such as fusion of the principal phyllaries into a cup and suppression of the calyculum. The section is of special interest for several reasons, not the least of these being that in the vicariad *Dyssodia Belenidium* — *D. Thurberi* it shows the bicentric geography, northern Argentina — northern Mexico, which parallels the geographic distributions of so many other plants (I. M. Johnston, 1940; Garcia, Soto, and Miranda, 1961; etc.) and which may indicate an antiquity of perhaps tens of millions of years (Croizat, 1952). Although *D. Thurberi* is morphically identical to *D. Belenidium* (Johnston, 1956a and 1956b), we here list the names separately because of the report that $2n = 32$ in *D. Belenidium*, whereas we have found that $n = 13$ in the single population of *D. Thurberi* from which we have been able to obtain countable chromosomes. The further discovery of the number $n = 13$ in three other species of this section leads to a suspicion that the report for *D. Belenidium* may be in error and at least needs confirmation.

Dyssodia pentachaeta, in the inclusive sense (Johnston, 1956a), is rather polymorphic and might be broken into several species satisfactorily. Extensive population sampling for cytological data is desirable, but the six counts here reported do not offer much hope that chromosome numbers *per se* will be helpful in an elucidation of the taxonomy. Moreover, we have found *D. pentachaeta* one of the most

difficult species from which to obtain countable material. The preliminary indication of two levels of ploidy in the somewhat polymorphic taxon *D. setifolia* (*sensu* Johnston, 1956a) also indicates that further sampling is desirable.

The section Hymenatherum is closely related to section Thymophylla. Even so ardent a proponent of segregate genera as Rydberg (1915) placed them together, in the genus Thymophylla. The species of section Hymenatherum show a greater specialization than those of any others of the genus. They are all annuals of the Texano-Mexican dry areas, some of them being much reduced ephemeral desert annuals. The calyculum is entirely suppressed and the involucral fusion proceeds so far that in several species the individual phyllaries are scarcely discernible. Furthermore the base chromosome number $x = 8$ prevails among these plants. These facts, together with the additional character that most of the section Thymophylla have strictly opposite leaves and branches whereas Hymenatherum shows an alternate arrangement, at least in the upper parts of the stems, might lead to the resurrection of Hymenatherum to the generic level. But other evidence militates against such a move, viz. the evidence presented here that in *Dyssodia tenuiloba* the group is dibasic with one population clearly showing $n = 13$, another $n = 8$, and observations by the senior author of a group of plants which were probably the result of hybridization between *D. tenuiloba* and *D. pentachaeta*, at one locality just south of Monterrey, Nuevo León (unfortunately, the station has now been obliterated by enlargement of a gravel pit).

Dyssodia micropoides, a species of depressed annuals with a clearly defined distribution largely restricted to the dry limestone piedmont of Coahuila and Nuevo León (Johnston, 1956a), has been something of an orphan, with no clear line of descent within the genus. Rydberg (1915) placed it, as the genus *Gnaphaliopsis*, immediately following his genus *Thymophylla*. The discovery of $n = 8$ for this taxon suggests that the species might best be placed near or with the section Hymenatherum.

The rare species, *Dyssodia neomexicana*, deserves special

comment for several reasons, one being that the present report extends the known distribution several hundred miles to the south. The species has previously been reported from Chihuahua, from the type locality in southwestern New Mexico, and from Apache County, Arizona. The plants are ephemeral annuals with opposite leaves below, alternate above, and an involucre very much like that of *D. aurea* of the section Hymenatherum except for larger size and the constant presence of a calyculum of a few linear bractlets.

FIG. 1-8. — Camera lucida drawings of the meiotic chromosomes of *Dyssodia* spp. — Fig. 1. *D. micropoides* ($n = 8$). — Fig. 2. *D. neomexicana* ($n = 7$). — Fig. 3. *D. Treculii* ($n = 16$). — Fig. 4. *D. tenuifolia* ($n = 8$). — Fig. 5. *D. acerosa* ($n = 8$). — Fig. 6. *D. aurea* ($n = 8$). Fig. 7. *D. tagetiflora* ($n = 13$). — Fig. 8. *D. decipiens* ($n = 13$). (× ca. 2000).

Rydberg (1915) placed the species in his monotypic genus *Trichaetolepis*, next to his segregate genus *Dysodiopsis*. We list the species among Hymenatherum largely because of lack of any other place to put it and because of the discovery of the low number of $n = 7$, which stands alone in the genus.

DISCUSSION

The "gap" between $x = 8$ and $x = 12, 13$ in this genus has been mentioned by Turner, *et al.* (1961) and compared to gaps in such genera as *Aster*, *Chrysopsis*, *Gutierrezia* and *Inula*. The idea that the present gap in *Dyssodia* is the result of inadequate sampling must not be rejected summarily. But dismissing it momentarily, we might suggest another explanation. The gaps, at least in some genera, not including *Dyssodia*, have been explained as the result of aneuploid loss to fairly low numbers (*ca.* 5) from an ancestral base of $x = ca.$ 9 (this hypothesis, or a modification of it, has been presented by several authors, Stebbins, *et al.*, 1953; Huziwara, 1958; Raven, *et al.*, 1960, etc.). On the other hand, Turner, *et al.* (1961) think it more plausible to postulate a fairly low ancestral base for the family ($x = 4$ or 5) and to consider the probability that in various phyletic lines we may detect aneuploid loss or gain in series both from the ancestral base and from derivative multiples of it. At any rate, regardless of the true etiology, we would like to reiterate the absence of any known mechanism to explain differential survivorship (i.e., natural selection) of certain chromosome numbers as compared to other chromosome numbers in the same phyletic or in the same aneuploid series. Nor does it appear likely that such a mechanism will suddenly come to light as a *deus ex machina* for the aneuploid-reduction loss hypothesis, or as an explanation of the situation in *Dyssodia*.

The gap in the *Dyssodia* series which includes numbers of $n = 9, 10, 11$, is not strictly comparable to the gap of $x = 6$, 7 and/or 8 in the genera named above. In the latter genera the counts clustering at 9 and 10 are very nearly double those clustering at 4 and 5, whereas in *Dyssodia* the higher bases of $x = 12, 13$ are not double the common lower base of $x = 8$. If we postulate an ancestral base $x = 8$ we must ex-

plain away a new "gap" of $x = 14$, 15, and if we postulate an ancestral base of $x = 7$, we must explain the present rarity of $n = 7$ and $n = 14$. Furthermore, in *Dyssodia* the gap occurs not simply between species or species groups but even within groups of plants so similar morphically that they have been considered to constitute a single species (e.g., *D. Belenidium*, *D. tenuiloba*, and *D. acerosa*). If one assumes an ancestral basic chromosome number of $x = 4$ for the genus *Dyssodia*, then much of the difficulty in explaining the

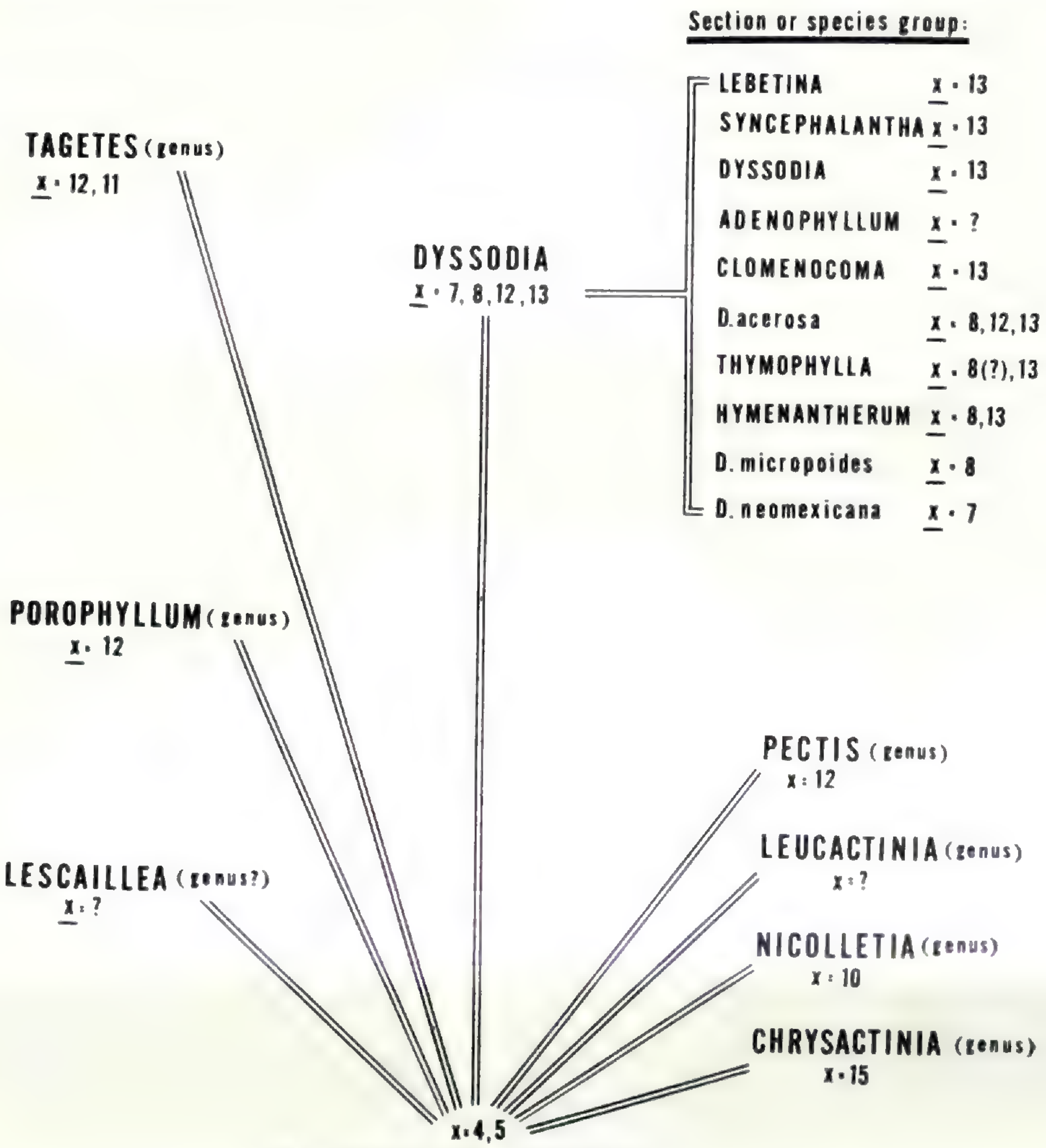

FIG. 9. Hypothetical phyletic relationships among genera, sections, and species of the genus *Dyssodia* and related genera.

TABLE 1. SPECIES OF DYSSODIA
ARRANGED IN A TENTATIVE CLASSIFICATION TOGETHER WITH
AVAILABLE CHROMOSOME COUNTS

Taxa	Voucher specimens and/or literature reference	Chromosome Nos. *n*	*2n*
Sect. *Dyssodia*			
D. papposa (Vent.) Hitchc.[c]			
D. tagetiflora Lag.	QUERÉTARO: 8 mi. n. of Querétaro, *Johnston 4026A*.	13 (Fig. 7)	
”	OAXACA: Oaxaca, *King 2942*.	13	
”	VERA CRUZ: 10 mi. sw. of Nogales, *King 2337*.	13	
D. pinnata (Cav.) Rob.	SAN LUIS POTOSI: La Capilla, *Rook M-452*.	13	
”	TAMAULIPAS: 11 mi. s. of Palmillas, *Johnston 5623*.	13	
”	MEXICO: 10 mi. w. of Toluca, *King 3591*.	13	
”	MEXICO: Rte. 55, 3 mi. from junction with Rte. 57, *Powell & Edmondson 582*.	13	
”	MEXICO: Rte. 57, 29 mi. s. of tollgate, *Powell & Edmondson 584*.	13	
Sect.[a] [Genus *Syncephalantha* Bartl.]			
D. decipiens (Bartl.) M. C. Johnston[b]	OAXACA: 10 mi. n. of Oaxaca, *King 2490*.	13	
”	OAXACA: 3 mi. se. of Oaxaca, *King 3468*.	13	
”	OAXACA: 9 mi. nw. of Oaxaca, *King 3514*.	13	
”	CHIAPAS: 19 mi. ne. of Las Cruces, *King 3445*.	13 (Fig. 8)	
Sect. *Clomenocoma* (Cass.) O. Hoffm.			
D. grandiflora DC.[c]			
D. Jelskii Hieron.[c]			
D. remota Blake[c]			
D. montana (Benth.) Gray[c]			
D. squarrosa Gray[c]			
D. speciosa Gray[c]			
D. aurantia (L.) Rob.[c]			
D. Cooperi Gray	Raven and Kyhos (1961)		26
D. porophylloides Gray	Raven and Kyhos (1961)	13	
Sect.[a] [Genus *Lebetina* Cass.]			

Taxa	Voucher specimens and/or literature reference	Chromosome Nos. n	$2n$
D. cancellata (Cass.) Gray	AGUASCALIENTES: 4 mi. s. of Aguascalientes, *Rock M-465.*	13	
"	DURANGO: 47 mi. n. of Durango. *Powell & Edmondson 956.*	ca. 13	
"	TAMAULIPAS: 5-6 mi. nw. of Ocampo, *King 3957.*	13	
D. porophylla (Cav.) Cav.	GUANAJUATO: 18 mi. w. of Salamanca, *Johnston 5949.*	13	
Sect. *Gymnolaena* DC.[c]			
D. oaxacana Greenm.			
D. serratifolia DC.			
D. integrifolia Gray			
D. Seleri Rob. & Greenm.			
Sect. *Adenophyllum* (Pers.) O. Hoffm.[c]			
D. coccinea Lag.			
Sect. *Aciphyllaea* DC.			
D. acerosa DC.	Raven and Kyhos (1961)		24
"	TEXAS: Crockett Co., 25 mi. w. of Ozona. *Johnston 6407.*	13	
"	TEXAS: Val Verde Co., Del Rio, *Johnston 6489.*	13	
"	TEXAS: Brewster Co., Elephant Mesa, *Johnston 6423.*	13[d]	
"	TEXAS: Brewster Co., 14 mi. e. of Marathon, *Johnston 6454.*	8 (Fig. 5)	
	COAHUILA: 5 mi. w. of Saltillo. *Powell & Edmondson 517.*	13[d]	
Sect.[a] [Genus *Dysodiopsis* (A. Gray) Rydb.][c]			
D. tagetoides T. & G.			
Sect. *Boeberastrum* Gray[c]			
D. littoralis Brandg.			
D. anthemidifolia Benth.			
D. concinna (A. Gr.) Rob.			
Sect.[a] [Genus *Urbinella* Greenm.][c]			
D. Palmeri (Greenm.) Macbr.			
D. Gentryi M. C. Johnston			
Sect. *Thymophylla* (Lag.) O. Hoffm.			
D. tephroleuca Blake[c]			
D. setifolia (Lag.) Rob. var. *setifolia*	COAHUILA: Carneros, *Johnston 4186.*		26

Taxa	Voucher specimens and/or literature reference	Chromosome Nos. n	$2n$
	"	SAN LUIS POTOSI: 8 mi. w. of Rioverde, *Johnston 5649*.	26
D. setifolia (Lag.) Rob. var. *setifolia*	TAMAULIPAS: 11 mi. s. of Palmillas, *Johnston 5629*.	ca.	26
	"	NUEVO LEÓN: 41 m. s. of Saltillo, *Rock M-274*.	ca.	26
D. setifolia var. *Greggii* (Gray) M. C. Johnston[c]			
D. aurantiaca (Brandg.) Rob.[c]			
D. Belenidium (DC.) Macl.	Covas and Schnack (1946)		32
D. Thurberi (Gray) A. Nels.	TEXAS: Brewster Co., 1 mi. n. of Black Gap, *Johnston 6443*.	13	
D. Hartwegii (Gray) Rob.	SAN LUIS POTOSI: 11 mi. e. of San Luis Potosí, *Johnston 4040a*.		26
	"	DURANGO: 57 mi. ne. of Durango, *King 3761*.	ca.	26
D. pentachaeta (DC.) Rob. sensu lato	NUEVO LEÓN: 30 m. s. of Saltillo, *Ellison 51*.		13
	"	COAHUILA: 5 mi. w. of Allende, *Johnston 4169*.		13
D. pentachaeta (DC.) Rob. sensu lato	COAHUILA: 5 mi. w. of Saltillo, *Powell & Edmondson 516*.	ca.	13
D. pentachaeta (DC.) Rob. sensu lato	SAN LUIS POTOSI: 8 mi. w. of Rioverde, *Johnston 5648*.		13[d]
D. pentachaeta (DC.) Rob.	TEXAS: Brewster Co., 8 mi. w. of Marathon, *Johnston 6449*.		13[d]
	"	TEXAS: Pecos Co., southern tip of co., *Johnston 6457*.	ca.	13
	"	TEXAS: Kinney Co., 8 mi. e. of Brackettville, *Johnston 6490*.		13[d]
Sect. *Hymenatherum* (Cass.) O. Hoffm.			
D. tenuiloba (DC.) Rob.	TEXAS: Webb Co., Laredo, *Johnston 5466*.		13[e]
	"	TEXAS: Brooks Co., 3 mi. e. of Falfurrias, *Johnston 5467*.		8[e]
D. Wrightii (Gray) Rob.	TEXAS: San Patricio Co., 3 mi. n. of Sinton, *Johnston 5468*.		8
	"	TEXAS: Goliad Co., 1 mi. w. of Refugio Co. line, *Johnston 5471*.		8
	"	TEXAS: Refugio Co., 2 mi. n. of Aransas River, *Johnston 5469*.	ca.	8

Taxa	Voucher specimens and/or literature reference	Chromosome Nos. n	$2n$
D. Treculii (Gray) Rob.	TEXAS: Val Verde Co., Del Rio, *Johnston 6488.*	16	(Fig. 3)
D. texana Cory[c]			
D. mutica M. C. Johnston	Johnston (1960)	8	
D. aurea (Gray) A. Nels. var. *aurea*			
D. aurea var. *polychaeta* (Gray) M. C. Johnston	COAHUILA: Bolsón de Mapimí, *Rock M-484.*	8	
"	COAHUILA: 10 mi. e. of San Pedro de las Colonias. *Powell & Edmondson 520.*	8[d]	
"	CHIHUAHUA: 14 mi. n. of Parral, *Powell & Edmondson 972.*	8	
	CHIHUAHUA: just east of Chihuahua City, *Powell & Edmondson 1018.*	8	(Fig. 6)
D. anomala (Canby & Rose) Rob.[c]			
D. tenuifolia (Cass.) Loes. (Incl. *D. Neaei* (DC.) Rob. and *D. diffusa* (Gray) Rob.)	SAN LUIS POTOSI: 7 mi. e. of San Luis Potosí, *Johnston 4041.*	8	(Fig. 4)
	Same locality, *Johnston 5638.*	8	
D. neomexicana (Gray) Rob.	MEXICO: 36 mi. s. of tollgate north of Mexico City, *Powell & Edmondson 588.*	7[e]	(Fig. 2)
Sect.[a] [Genus *Gnaphaliopsis* DC.]			
D. micropoides (DC.) Loes.	NUEVO LEON: w. of Monterrey, *Rock M-496.*	8	
"	NUEVO LEON: 26 mi. s. of Sabinas Hidalgo, *Johnston 5455.*	8	
"	COAHUILA: San Lázaro, *Johnston 4184.*	8	(Fig. 1)

[a]No nomenclatural combination has been published for this taxon at the proper rank. Formal changes in status are not deemed appropriate for this contribution, but must await a formal taxonomic treatment.

[b]**Dyssodia decipiens** (Bartl.) M. C. Johnston, comb. nov., based on *Syncephalantha decipiens* Bartl., Ind. Sem. Hort. Goett. 1836: 6. 1836.

[c]No chromosome counts have been made or reported for this taxon.

[d]One or two fragments were also seen.

[e]This count was quite clear and unequivocal.

obvious gap is removed. Thus taxa with $n = 8$ would be tetraploid; $n = 12$, hexaploid; and taxa with $n = 7$ and 13 aneuploid derivatives from such taxa. The fact that at least

one species, *D. acerosa*, has chromosome numbers $n = 8$, 12, 13 might be explained by the hypothesis of Turner, *et al.* (1961) that the Compositae showed a very rapid and explosive evolution while still at the predominately diploid level of $x = 4$ and 5, most of the generic lines being formed at that time. Surviving diploid taxa, in that they are for the most part not buffered against mutational change (Stebbins, 1950) and are thus more prone to rapid evolution, should be relatively more specialized.

The data and some of our speculations are summarized in Fig. 9. We can do no more at present than to pose the problems and remark that at the very least the picture must tantalize the would-be phylogenist. — THE PLANT RESEARCH INSTITUTE, DEPARTMENT OF BOTANY, THE UNIVERSITY OF TEXAS, AUSTIN

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THE PARASITIC BEHAVIOR OF *MELAMPYRUM LINEARE* AND A NOTE ON ITS SEED COLOR[1]

MARTIN A. PIEHL

Parasitism has been described for several members of the genus *Melampyrum*, the cow-wheats (Scrophulariaceae), beginning with *M. arvense* of Europe (Decaisne, 1847). To my knowledge, however, a parasitic existence has not been substantiated for *M. lineare*, the single North American representative of the genus. Fraysse (1906) ascribes to Heinricher (1904) the assertion that all species of the genus are parasitic; however, the latter actually said (p. 412), "Alle untersuchen Arten der Gattung *Melampyrum* sind parasitisch *(M. arvense, barbatum, nemorosum, silvaticum, pratense)*", and no reference was made to *M. lineare*. Shreve

[1]Contribution from the University of Michigan Biological Station.

et al. (1910) failed to find parasitic connections for *M. lineare* in Maryland but state that this plant was reportedly parasitic farther north[2], and Pennell (1935) whose studies included field observations makes no mention of parasitism. The lack of information concerning this species' parasitism has received comment previously (Beauverd, 1916; Marie-Victorin, 1935).

While studying the parasitism of *Comandra, Pedicularis,* and other angiosperms, I have had occasion to examine *M. lineare* for comparative purposes. The majority of my observations were made during the spring and summer of 1957, 1958, and 1960 in the Mackinac Straits region, Michigan. Here *M. lineare* often occurs in dense clumps several decimeters across, suggesting seeding from one or more plants which previously grew nearby. Its characteristic habitat is open woodland, including both sandy, often dry sites under conifers and more mesic aspen stands. Rarely it occurs in bogs.

This species is an opposite-leaved annual, which in the study area is usually about 2 dm. tall at flowering, with considerable variation in height. In contrast to achlorophyllous holoparasites, e.g., *Orobanche* spp., there is no suggestion of the parasitic habit in the aerial parts of such semiparasites — the plants are green and the leaves are not proportionately smaller than those of many autotrophs. The whitish root system is shallow, consisting of a poorly defined primary root which is surpassed by some of the several lateral roots. There are comparatively few root hairs, a condition which has also been described for the European *M. pratense* (Koch, 1887). The excavated root system gives the appearance of extending only a few centimeters into the soil; however, the slender rootlets break easily, obscuring its full extent. This breakage explained my failure to find parasitic connections in the initial excavations. Minute swellings on the roots were nonetheless detected, and upon close examination some were found attached to fragments of foreign plant tissue. Later excavation was facilitated by selecting plants

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[2]Additional information was not given by Shreve et al. as to when, where, and by whom this observation was made.

in loose, dry sand, and after repeated attempts involving careful brushing away of sand, a thread-like rootlet was found attached to a host root by a near-microscopic, hemispherical enlargement — the haustorium. Subsequently, it was determined that haustoria develop on essentially all plants of *M. lineare*, and that rhizomes as well as roots are parasitized. By ordinary excavation with a trowel the fragile parasite roots leading to connections were severed, leaving the haustoria attached to the host, and thus destroying direct evidence of parasitic connections. The delicateness of the attachments has undoubtedly contributed to the lack of observations on the parasitic behavior of this species.

The haustoria are developed laterally along the parent root, although at times they appear terminal because root growth beyond the haustorium has been arrested. A similar development is known for other semiparasites (Herbert, 1923; other authors). Often several haustoria develop in close succession from a single parasite root (Plate 1265, C). Unicellular, epidermal hairs develop from just above the distal end of some haustoria and may reach down to, or even extend for some distance over, the surface of the host root or rhizome (Plate 1265, D). Their development appears to be associated with the early ontogeny of the haustorium. Presumably they function as ordinary root hairs for a short time, and later may aid (very slightly) in superficial attachment of the haustorium to the host. Similar hairs occur on other species, e.g., *M. pratense* (Knorz, 1848; Koch, 1887).

Anatomically, the haustorium consists of an outer region of loosely-organized, sometimes partly-collapsed, parenchymatous cells, and a central region of compact, densely-protoplasmic cells. Through the latter region pass one or a few vessels, leading to the distal, invading portion, and eventually effecting direct continuity between the xylem of the parasite root and that of the host. I plan to discuss further anatomical details in a later report.

The haustoria are nearly circular in surface view and are ca. 0.5 (0.2-1.4) mm. in diameter, depending somewhat on the size and nature of the root or rhizome parasitized. The smaller haustoria are produced from fine rootlets with dia-

meters down to 0.1 mm. and are attached to host rootlets of about the same thickness. In general, host organs are ca. 1 mm. in diameter, although on occasion those of greater thickness are attacked. Among the largest observed were roots of large-toothed aspen *(Populus grandidentata)* 5 mm. in diameter, while those of blackberry *(Rubus* cf. *alleghe-niensis)* and the rhizomes of bracken *(Pteridium aquilinum)* were nearly as large. A maximum number of 26 haustoria per linear centimeter of host root was recorded for aspen roots of this size. Since this count was made from preserved material, even more haustoria may have been present which were unavoidably dislodged during collection. On the rough-ened bark of these relatively large aspen roots, haustoria tended to form in the furrows rather than on ridges, and were often insecurely attached. When sectioned, these haus-toria were found to have penetrated a part of the compara-tively thick bark but had not reached living tissue. Apparently the thickness and other characteristics of the bark of some hosts limit the size of roots which can be suc-cessfully attached. When attached to larger host organs, haustoria have a slightly concave, sucker-like distal surface, while on smaller organs they are often clasping, as they partly enclose the host. Haustorial roots tend to grow paral-lel to large organs (Plate 1265, E), while they often contact smaller ones at an angle.

Haustorial connections to 12 species have been detected. These are taxonomically distributed over two phyla, in one of which three classes and two subclasses are involved. Eight of the hosts are dicots, but these belong to several generally diverse families. The species to which attachments have been found follow:

Sphagnum capillaceum (Weiss) Schrank[3]
Pteridium aquilinum (L.) Kuhn
Pinus resinosa Ait.
Carex pensylvanica Lam.
Populus grandidentata Michx.
Betula papyrifera Marsh.
Quercus rubra L.
Amelanchier cf. *arborea* (Michx. f.) Fern.
Rubus cf. *allegheniensis* Porter
Gaultheria procumbens L.
Melampyrum lineare Desr.
Diervilla lonicera Mill.

[3]Although very little material was available for identification, Prof. H. L. Blomquist believes it belongs to this species.

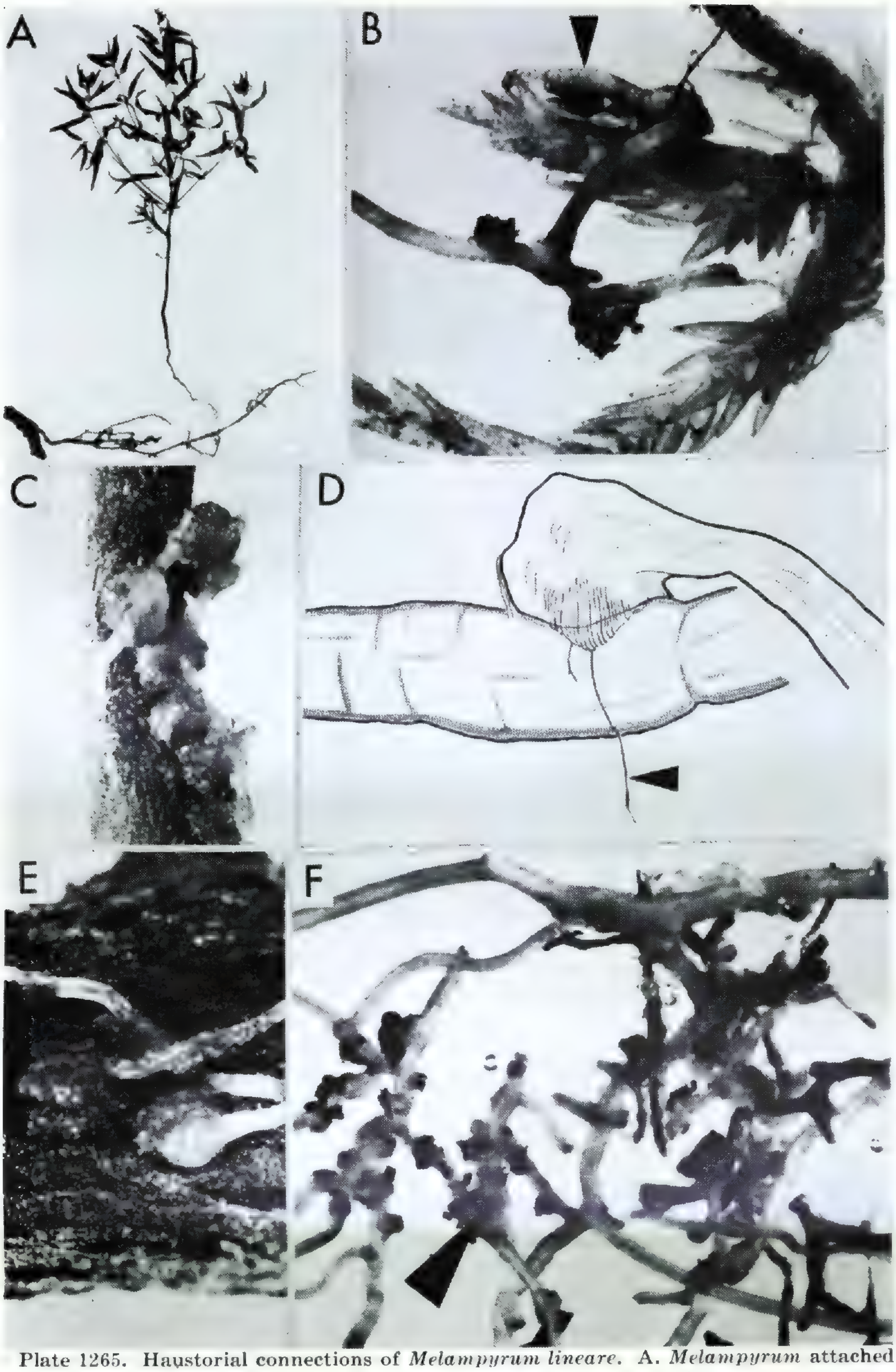

Plate 1265. Haustorial connections of *Melampyrum lineare*. A. *Melampyrum* attached to a *Pinus resinosa* root, × ¼. B. Haustorial connection to *Sphagnum capillaccum* (pointer), × 12. C. Closely successive haustoria on a *Populus grandidenta* root, × 12. D. Single haustorium showing exceptionally strong development of hairs; a few hairs prolonged over the host root (pointer), × 36. E. Isolated haustoria formed from *Melampyrum* roots paralleling an unusually large host root *(Populus grandidentata)*, × 9. F. Self-parasitic connection (pointer), connections to dead roots and humus (small black particles), × 12.

Undoubtedly many more hosts can be added with further observation. The host ranges reported for several European species of *Melampyrum* are limited to gymnosperms and angiosperms (Heinricher, 1924). Heinricher also states that these cow-wheats differ from each other somewhat in their ability to grow on certain hosts.

Occasionally, I have found cases of intraspecific parasitism, where connections are formed to other individuals of *M. lineare* growing nearby. Furthermore, self-parasitism, involving other roots of a single individual, has been observed (Plate 1265, F). In general, the external features of attachment and penetration are the same here as in cases involving other species.

My single observation of *Sphagnum* as a host was made at (Inverness) Mud Lake Bog, Cheboygan County, Michigan, where haustoria were found attached to the lower achlorophyllous portion of the moss some distance below the mat surface (Plate 1265, B). Whether this should be considered a case of true parasitism is questionable, for although the upper portion of the moss was alive, the part to which haustoria were attached may have consisted wholly of dead cells. Attachments to a bryophytic host have not previously been recorded for a parasitic angiosperm.

In addition I have found numerous cases of what appears to be saprophytism, for the haustoria were attached to dead fragments of plant tissue (Plate 1265, F). These fragments can often be recognized as dead and sometimes partly decayed roots, and occasionally as other organs. In some instances haustorial connections were formed to unidentifiable humus particles. Those roots still intact, as well as the *Sphagnum* mentioned above, could have died subsequent to invasion; however, this is not possible for the already much-decayed material. Thus, living tissue is not a prerequisite for attachment. Whether substances are obtained from the dead material is unknown. This observation of attachments to dead tissues agrees with those of *M. pratense* (Knorz, 1848; Koch, 1887); however, these workers believed this species formed attachments to dead material only, and described it as saprophytic rather than parasitic. Attachments

of *M. pratense* to living plants as well have since been reported (Sperlich, 1902).

I have frequently observed some individuals of *M. lineare* in a wilted condition in nature, and as collectors soon learn, this species is one of the first to wilt, even when kept in a vasculum. I suspected that those plants which wilted easily had relatively few haustorial connections, and subsequent examination of their roots tended to verify this. This propensity to wilt, and if the drought continues, to succumb, is consistent with the observation that this species tends to be morphologically unadapted to xeric conditions; paradoxically, however, it frequents dry sandy habitats. The partial heterotrophy of this plant may well be vital to its success under such conditions.

An observation concerning seed color in *M. lineare* seems worthy of inclusion here. Although the seeds have been described as blackish[4] (Pennell, 1935; Fernald, 1950), I have repeatedly noted that they are beige or tan with a lighter colored tip (elaiosome according to Gislén, 1949) when released from the capsules. Ungerminated seeds found at or near the soil surface early the following spring are similarly colored, suggesting that the blackening is not a normal after-ripening change. However, seeds from herbarium specimens from various parts of the range are almost always blackish, and apparently form the basis for previous descriptions. Reference to seeds of my own specimens which were recorded as beige in the field showed that they had blackened after the specimens were dried and pressed, and germination attempts indicated such seeds were inviable. Also, some specimens blacken throughout when dried, a phenomenon which is rather common in both the Euphrasieae and Buchnereae sensu Pennell. Whether such a color change occurs in seeds of the European species is unknown, but if it does, an interesting etymological situation arises when one considers the generic name.

SUMMARY

Although previously known for European members of the

[4]Pennell describes them as brown or dark brown to blackish for ssp. *pectinatum* which is not known from northern Michigan.

genus, parasitism is substantiated for the first time for *Melampyrum lineare* Desr. from studies in Michigan. Subterranean connections of this seemingly wholly autotrophic angiosperm are established by extremely fine roots bearing minute haustoria. Invasion of the host root or rhizome ordinarily effects direct connection between the xylem of the host and that of the parasite. The hosts are taxonomically diverse — dicots, monocots, conifers, ferns, and in one instance, a bryophyte. *Melampyrum lineare* can also be self-parasitic. In addition, it forms attachments to dead plant parts and humus.

Descriptions of the seeds of *M. lineare* as blackish are believed based on dead, dried material which has blackened after collection. Mature seeds in nature have been observed to be beige or tan.

ACKNOWLEDGMENTS

I wish to acknowledge the helpful suggestions of Professors W. S. Benninghoff, Rogers McVaugh, W. H. Wagner, Jr., and E. G. Voss of the University of Michigan in connection with the preparation of the manuscript. — DEPARTMENT OF BOTANY, UNIVERSITY OF MICHIGAN, ANN ARBOR.

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FURTHER NOTES ON THE DISTRIBUTION OF BIDENS CONNATA VARS. PINNATA AND GRACILIPES

EARL EDWARD SHERFF

Fassett (Rhodora 30: 31-35, Plate 160. 1928) listed the six varieties of *Bidens connata* Muhl. known to him in the State of Wisconsin: vars. *typica (connata), fallax, petiolata, ambiversa, anomala,* and *pinnata.* For the last of these, var. *pinnata* Wats., he listed but two collections from Wisconsin, these from Polk County (see also Aldrich & Fassett, Science 70: 45. 1929). Subsequently he collected, either alone or with some of his students, numerous specimens of var. *pinnata* from various other counties in northwestern Wisconsin. Through the kindness of Dr. H. Iltis of the Department of Botany of the University of Wisconsin, I have been permitted to examine those specimens critically. Moreover, in early September of 1961, I made visits to some of the localities where Fassett had collected and this permitted me to observe the living specimens in their native habitats. Suites of specimens were obtained to distribute to herbaria. As a contribution to the study of Wisconsin's flora, there follows here a condensed list of all Wisconsin specimens of var. *pinnata* studied by me. My own collections may be found represented in the Herbarium of the Chicago Natural History Museum (F); the others are in the Herbarium of the University of Wisconsin:

CHIPPEWA COUNTY: *N. C. Fassett, John Budd, & C. L. Brynildson 22695*, sandy shore of Bass Lake, 12 miles north of Bloomer, Oct. 2, 1949. BARRON COUNTY: *W. T. McLaughlin 1020*, sandy shore of Crystal Lake, Comstock, Aug. 29, 1929; *McLaughlin 1021*, sandy shore of Horseshoe Lake, Turtle Lake, Aug. 28, 1929; *McLaughlin 1055*, sandy shore of Silver Lake, Cumberland, Aug. 29, 1929. POLK COUNTY: *N. C. Fassett 7891*, sandy shore of Bass Lake, 9 miles west of Luck, Sept. 23, 1928; *Fassett & L. R. Wilson 4016*, sandy shore of Poplar Lake, Osceola, Sept. 4, 1927 (3 sheets); *W. T. McLaughlin 1024*, sandy shore of Pine Lake, Star Prairie; *McLaughlin 1026*, narrow sand strip, Twin Lake, Amery, Aug. 25, 1929; *McLaughlin 1030*, grass-invaded shore, small pond, Star Prairie, Aug. 26, 1929. WASHBURN COUNTY: *N. C. Fassett 7900*, sandy shore of Shell Lake, Shell Lake, Sept. 22, 1928; *Fassett 7901*, same place and date; *Fassett 7906*, sandy shore of Silver Lake, Lampson, Sept. 15, 1928; *Fassett 7907*, sandy shore of small lake 2 miles northeast of Sand Lake, 12 miles northwest of Minong, Sept. 6, 1928; *Fassett 7911*, wet, sandy shore of Sand Lake, 12 miles northwest of Minong, Sept. 6, 1928; *Fassett 7912*, at water's edge, sandy shore of Wood Lake, 12 miles northwest of Minong, Sept. 6, 1928; *Fassett 11971*, sandy shore of same lake, same date; *Fassett 17644*, bog, Devil's Lake, Sarona, Sept. 14, 1935 (2 sheets); *Fassett 17645*, sandy shore of Bass Lake, Sarona, Sept. 14, 1935; *Fassett & W. T. McLaughlin 10891*, shore of Mathews Lake, Trego, Sept. 11, 1929; *Fassett & McLaughlin 10892*, shore of Cable Lake, Spooner, Sept. 12, 1929; *Fassett & McLaughlin 10893*, sandy shore of McKinley Lake, Trego, Sept. 12, 1929; *Fassett & McLaughlin 10894*, shore of Cable Lake, Spooner, Sept. 12, 1929; *Fassett & McLaughlin 10895*, sandy shore of Horseshoe Lake, Minong, Sept. 12, 1929; *Fassett & McLaughlin 10896*, shore of McLain Lake, Minong, Sept. 12, 1929; *Earl E. Sherff XY6002*, sandy and stony east shore of Silver Lake, south of Minong, Sept. 1, 1961; *Sherff XY6003*, sandy west shore of Shell Lake, Shell Lake, Sept. 1, 1961; *Sherff XY6004*, sandy shore of Little Long Lake, west of Spooner, Sept. 1, 1961; *Homer Stevens 187*, bog beyond "Hogin's" on Route M, Aug. 28, 1947. BURNETT COUNTY: *N. C. Fassett 1214*, sandy shore of Devil's Lake, Webster, Sept. 6, 1929; *Fassett 7898*, sandy shore of Long Lake, Hertel, Sept. 19, 1928; *Fassett 7899*, sandy shore of Crooked Lake, Siren, Sept. 19, 1928; *Fassett 7902*, sandy shore of Clear Lake, Siren, Sept. 19, 1928; *Fassett 7904*, shore of Hanscon [Hanscomb] Lake, Webb Lake, Sept. 21, 1928; *Fassett 7905*, sandy shores of Long Lake and Sucker Lake, Webb Lake, Sept. 21, 1928; *Fassett & J. W. Thomson 18715*, shore of Fish Lake, south of Webb Lake, Sept. 17, 1937; *W. T. McLaughlin 1018*, sandy shore of Clear Lake, Siren, Aug. 21, 1929; *McLaughlin 1019*, sandy shore of Conners Lake, Webster, Aug. 19, 1929; *McLaughlin 1025*, sandy shore of Macaboyne Lake, Webb Lake, Aug. 18, 1929; *McLaughlin 1028*, sandy shore of Devil's Lake, Webster, Sept. 1, 1929; *McLaughlin 1032*, sandy shore of Fish Lake, Webb Lake, Aug. 17, 1929; *McLaughlin 1033*, sandy shore of a

small lake, Webb Lake, Sept. 11, 1929; *McLaughlin 1035*, sandy shore of Ham Lake, Webster, Sept. 10, 1929; *McLaughlin 1036*, sandy shore of Long Lake, Webb Lake, Sept. 11, 1929; *McLaughlin 1037*, sandy shore of Sucker Lake, Webb Lake, Sept. 11, 1929; *McLaughlin 1038*, sandy shore of small lake north of Sand Lake, Gaslyn, Sept. 4, 1929; *McLaughlin 1039*, sandy shore of Loon Lake, Danbury, Sept. 3, 1929; *McLaughlin 1040*, sandy shore of Oak Lake, Gaslyn, Aug. 24, 1929; *McLaughlin 1041*, sandy shore of Long Lake, Hertel, Aug. 15, 1929; *McLaughlin 1042*, sandy shore of Birch Island Lake, Birch Island, Aug. 17, 1929; *Earl E. Sherff XY6005*, sandy shore of Crooked Lake, 1 mile north of Siren, Sept. 2, 1961, a form approaching in its foliage var. *gracilipes* Fern.; *Sherff XY6007*, sandy shore of Benach Lake (N. W. corner of sect. 29, tshp. 40N., R.15W.), ±27 miles (by road) northwest of Spooner, Sept. 2, 1961; *Sherff XY6008*, sandy shore of Mallard Lake, Sept. 2, 1961; *Sherff XY6009*, sandy shore of small lake near Mallard Lake, Sept. 2, 1961; *Sherff XY6010*, very abundant on sandy north shore of North Sand Lake, northwest of Gaslyn, Sept. 2, 1961. BAYFIELD COUNTY: *N. C. Fassett 7884*, sandy shore of McDonald Lake, Barnes, Sept. 11, 1928; *Fassett 7894*, same place and date; *Fassett 7903*, sandy shore of Pigeon Lake, west of Drummond, Sept. 3, 1928; *Fassett 7914*, sandy shore of Lake Ruth, Iron River, Sept. 3, 1928; *Fassett 7915* (1-2 meters from water, sandy shore of) and *7916* (at water's edge of) Island Lake, Barnes, Aug. 29, 1928; *Fassett 7946*, muddy shore of Lake Ellison, Barnes, Sept. 2, 1928; *W. T. McLaughlin 1017*, sandy shore of Lake Ruth, Iron River, Sept. 13, 1930; *Earl E. Sherff XY6001*, sandy south shore of Pigeon Lake, west of Drummond, Sept. 1, 1961. DOUGLAS COUNTY: *G. H. Conklin*, sandy shore of Whitefish Lake, Aug. 11, 1929; *N. C. Fassett 7892*, sandy shore of Wilderness Lake or Pattangel Lake,* Barnes, Sept. 15, 1929; *Fassett 7897*, sandy shore of Murray Lake, 12 miles east of Solon Springs, Sept. 2, 1928; *Fassett 7908*, under eaves of shed on sandy shore of Loon Lake, Wascott, Sept. 6, 1928 (2 sheets, "a" and "b"); *Fassett 7909*, wet, sandy shore of Whitefish Lake, Wascott, Sept. 6, 1928; *Fassett 7910*, same place and date; *Fassett 11970*, sandy shore of Halfway Lake, Gordon, Aug. 18, 1929; *W. T. McLaughlin 1016*, sandy shore of Simms Lake, Sept. 13, 1930; *McLaughlin 1027*, sandy shore of Halfway Lake, 2 miles south of Gordon, Sept. 13, 1930.

Particular notice was given the var. *pinnata* specimens in the live state to see if there were transitions to the less compound types of leaves characteristic of *B. connata* var. *gracilipes* Fern., a variety found in similar habitats, edges of sandy lake shores, at various localities in Wisconsin and

*Fassett's label gives the location for the lakes as Sect. 6, T. 45 N. R. 8 W. in Douglas County, but Barnes itself is across the county border in Bayfield County.

often interspersed with var. *pinnata*. No definite transitions of var. *pinnata* into var. *gracilipes* were found.

As previously stated in my revisional treatment of *Bidens* (Sherff, The Genus Bidens, Bot. Ser. Field Mus. Nat. Hist. **16**: 262. 1937), the var. *pinnata* was known to range geographically through parts of Minnesota (where the type had been collected at Richfield in Hennepin County) and Wisconsin. On several trips in the autumn of 1961 to lakes in western Michigan, I was unable to find var. *pinnata*, even though the lakes possessed sandy shores identical with those of the Wisconsin habitats. So far, then, as I have been able to determine, var. *pinnata* is limited to Minnesota and Wisconsin.

Special attention was given the same season also to the occurrence of the var. *gracilipes* Fern. This variety is extremely interesting in the matter of its distribution. As was stated in my above-cited monograph of *Bidens* (p. 261), the type of var. *gracilipes* was a plant collected at Harwich, far out on Cape Cod, Massachusetts. A few other specimens were found, ranging from Maine to Connecticut. From the known facts at that time, therefore, var. *gracilipes* seemed to be an endemic variety of the northeastern United States. The researches of Fassett upon the Wisconsin Flora, however, revealed the presence of the variety at numerous sites in Wisconsin. Some specimens were cited by him in the paper referred to above (Rhodora *loc. cit.*) and many additional ones were collected by him later on, either singly or in the company of his students, and deposited in the herbarium of the University of Wisconsin. It was my privilege to examine all of these recently and to confirm his determinations.

Subsequent to Fassett's publications, Mr. and Mrs. Hanes, in their Flora of Kalamazoo County, Michigan (page 259. 1947) cited var. *gracilipes* for Kalamazoo County, Michigan. Later, I myself cited (Brittonia **11**: 190. 1959) a Hanes specimen for the same county. Again, in Rhodora of May, 1961, I cited material, *C. W. Bazuin 4282*, from the "sandy shore of Wolf Lake, 3-4 miles east of Muskegon, Michigan," a habitat "roughly seventy miles farther north and twenty

miles farther west than the habitat" where the Kalamazoo County specimen had been collected. Unfortunately the last two papers had been compiled with the thought of collaborating in the production of a new Flora of Michigan, which authorities at the University of Michigan contemplate publishing (*vide* Mich. Flora Newsletter no. 7, Univ. of Mich., Nov. 25, 1960) and thus I inadvertently described the Wolf Lake habitat as being "the farthest point west at which the variety .... was known to occur." The words "in Michigan" should have been added after "west" of course, to indicate a cognizance of the many habitats known to occur for the variety in Wisconsin. — Having the entire United States in mind, then, we may put Wisconsin as marking the western limit of distribution for var. *gracilipes*. Indeed, from the comparative abundance of var. *gracilipes* specimens in Wisconsin, it seems very probable that Wisconsin was the real center of origin for the variety, and that specimens found in New England states had originally grown there from achenes transported from the west, presumably with the aid of their retrorsely barbed aristae.

Returning to the occurrence of var. *gracilipes* in Michigan, I have been able, in the autumn of 1961, to find specimens of it growing in a seemingly discontinuous distribution beginning with Kalamazoo County at the south and extending northeastwardly into Ionia County, thence northwestward into Kent County and Muskegon County, thence far northnortheastward into Lake County, to a point (Wolf Lake) some seven miles north of Baldwin. Ample material was obtained for herbarium specimens and was turned over to the Chicago Natural History Museum for accession and distribution to other institutions. A list of *exsiccatae* by counties follows:

KALAMAZOO COUNTY: *E. E. Sherff XY6016*, sandy north shore of Eagle Lake,* Oct. 5, 1961: *Sherff XY6017*, sandy shore of east side of Eagle Lake, same date. IONIA COUNTY: *Sherff XY6015*, sandy spot on north shore of Jordan Lake, Lake Odessa, Sept. 29, 1961. KENT COUNTY: *Sherff XY6012*, sandy shore of Long Lake, east of Kent City, Sept. 18, 1961. MUSKEGON COUNTY: *Sherff XY6013*, sandy southwest

*This and the next references are to the Eagle Lake southwest of Oshtemo.

shore of Wolf Lake, Sept. 18, 1961. LAKE COUNTY: *Sherff XY6011*, sandy east shore of Wolf Lake, ±7 miles north of Baldwin, Sept. 6, 1961.

Throughout my examinations of var. *gracilipes* in the field at the above-mentioned Michigan habitats, attention was paid to the foliar variations in the direction of var. *pinnata*. Such variations were found to be rare. In the suite numbered *XY6016*, composed of some twenty or more small, depauperate plants, two were found to have several leaves each with two pairs of slenderly lanceolate lateral leaflets or pinnae, instead of a single pair of broader ones. Apparently this was the maximum extent to which var. *gracilipes* approached var. *pinnata*. To summarize, then, while the var. *pinnata*, as stated earlier, was not found to intergrade into var. *gracilipes*, the latter variety was found, though very rarely, to offer a slight approach in leaf-form to var. *pinnata*. There was no indication, however, that the two varieties were not distinct or worthy of being accorded separate status. — CHICAGO NATURAL HISTORY MUSEUM.

THE ANNUAL SPECIES OF HOUSTONIA IN ILLINOIS

ROBERT H. MOHLENBROCK AND LEO E. HALBIG

The genus *Houstonia* in northeastern North America is represented by two well-defined groups. One group contains delicate, vernal-flowering annuals with single-flowered peduncles, salverform corollas, and globular seeds. The other contains coarser, summer-flowering perennials with a compound inflorescence, funnelform corollas, and rather flattened seeds.

This paper is concerned with the annual vernal species in Illinois. A subsequent paper will be devoted to the perennial species.

Four or five species of the annual bluets occur in northeastern North America. (The discrepancy arises from the status of *H. faxonorum* Fern. or *H. caerulea* var. *faxonorum* Pease and Moore). Three of these are attributed to Illinois in varying degrees of abundance by different workers.

Houstonia serpyllifolia Michx., from the mountains of Pennsylvania south to Georgia, does not occur in Illinois.

A check of any manual concerning the Illinois flora would lead one to believe that *H. caerulea*, *H. pusilla*, and *H. minima* are more common than is actually the case.

The latest treatment on distribution of Illinois vascular plants is that by Winterringer and Evers[1]. These workers list *H. caerulea* from ten Illinois counties along the eastern border and the southern fourth of the state. The present study reveals that five of the six reports from southern Illinois are based on misidentifications. The sixth report from St. Clair County late last century is likely a case of mixed labels since the collector often was guilty of this.

Winterringer and Evers attribute *H. minima* to 17 Illinois counties, including 3 in the southern tip of the state. Our study shows *H. minima* to occur in 17 counties, but to be absent in the extreme southern counties of Jackson and Saline. Records from these counties are based on misidentifications for *H. pusilla*.

Houstonia pusilla is limited in Illinois to the southern one-third of the state. The present study has enabled us to fill in most of the gaps in its distribution in southern Illinois.

Since all three species are reported to occur in southern Illinois with seeming regularity, the senior author thought it strange that on his many field trips and those of his colleagues and students, no authentic material of two of these — *H. caerulea* and *H. minima* — showed up in the collections.

During the spring of 1961, the junior author made vast collections of annual bluets throughout southern Illinois. These were studied intensively before being pressed for the herbarium. In the entire collection of several hundred specimens, there appeared no *H. caerulea* and no *H. minima*. All specimens were unquestionably *H. pusilla*.

Why, then, are there so many apparently erroneous reports of *H. caerulea* and *H. minima?* There is general agreement among field botanists that each species has a distinctive

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[1]Winterringer, G. S. and R. A. Evers. 1960. New Records for Illinois Vascular Plants. Illinois State Museum, 135 pp.

field recognition character. *Houstonia caerulea* is distinguished by the yellow eye or center in each flower, while the other species basically have a dark, usually reddish eye. A hurried glance at the flower either of *H. pusilla* or *H. minima* might reveal a yellow center, due to the presence of pollen on the mature anther, and thus this may account for the erroneous reports of *H. caerulea* in southern Illinois. Anyone familiar with the larger, pale-flowered *H. caerulea*, with its conspicuous yellow center, could never confuse this species with any other.

Houstonia minima sometimes is recognized in the field by its tiny stature. In our study, we have found *H. pusilla* as dwarfed as 1 cm. tall, during anthesis. Local naturalists, on being shown this specimen, immediately respond with *H. minima*. The only valid criterion to distinguish *H. minima* and *H. pusilla* is not stature, but relative length of calyx to corolla. *Houstonia minima* has a calyx equalling the corolla tube in length, while *H. pusilla* has a calyx barely half the length of the corolla tube. Although no specimens of *H. minima* were discovered in the field in southern Illinois during this study, there exists an authentic specimen in the University of Illinois herbarium of this species from Johnson County. Efforts to relocate this population have failed.

Since most modern manuals fail to give complete descriptions of *H. caerulea*, *H. pusilla*, and *H. minima*, it seems desirable to present descriptions in this paper.

KEY TO THE ANNUAL SFECIES OF HOUSTONIA IN ILLINOIS

1. Flowers pale blue or lilac, with a broad, pale yellow center; corolla tube 5-10 mm. long; capsule 3-4 mm. wide ..... 1. *H. caerulea.*
1. Flowers purple, with a small dark, usually red, eye; corolla tube 3-5 mm. long; capsule 2-3 mm. wide.
   2. Calyx lobes 1.2-1.9 mm. long, half as long as corolla tube ..... 2. *H. pusilla.*
   2. Calyx lobes 2.0-3.5 mm. long, equalling the corolla tube ..... 3. *H. minima.*

1. **Houstonia caerulea** L. Sp. Pl. 105. 1753.

Slender, tufted annuals; stems erect, flexuous, rather sparsely branched, to 15 cm. tall (in Illinois), glabrous or rarely puberulent; rosette leaves obovate to elliptic to spatulate, obtuse to subacute at apex, 4-15 mm. long, 2-6 mm. broad, glabrous or short hairy; petiole 1-6 mm. long, glabrous or sparsely puberulent; cauline leaves much

reduced, 2-7 mm. long, 1-3 mm. broad; peduncles filiform, 2-7 cm. long, glabrous or nearly so; bracts resembling the cauline leaves; sepals oblong, acute, 1.0-2.5 mm. long, glabrous; corolla salverform, pale blue to lilac to rarely nearly white, with a large yellow center (eye), the tube 5-10 mm. long, glabrous, the flower 10-15 mm. wide; capsule bilobed, flattened, 3-4 mm. wide, broader than long.

Habitat. — Open woods and fields.

General Range. — Nova Scotia to Wisconsin south to Missouri and Georgia.

Illinois Range. — Four eastern border counties; absent from the extreme south.

Date of Flowering in Illinois. — April 7 to May 17.

2. **Houstonia pusilla** Schoepf, in Reise 2:306. 1788.

Houstonia patens Ell. Bot. S. C. & Ga. 1:191. 1816.

Usually tiny, tufted annuals; stems erect, stiffer than the preceding, 1-12 cm. tall, glabrous; rosette leaves ovate to elliptic, subacute to acute, 5-10 mm. long, 3-7 mm. broad, glabrous and usually scaberulous along the margins; cauline leaves smaller and narrower; petiole 1-3 mm. long, glabrous; peduncles 1-4 cm. long, glabrous or nearly so; bracts resembling the upper cauline leaves; sepals linear to narrowly oblong, acute, 1-2 mm. long, glabrous; corolla salverform, deep purple, usually with a dark reddish center (eye), the tube 3-5 mm. long, about twice the length of the calyx, glabrous, the flower 4-8 mm. wide; capsule bilobed, flattened, 2-3 mm. wide, slightly longer than broad.

Habitat. — Xeric sandstone bluffs, open woods, fields, and pastures.

General Range. — Virginia to Missouri south to Texas and Florida.

Illinois Range. — The southern one-third of the state, north to Montgomery County.

Date of Flowering in Illinois. — March 22 to May 4.

Five-merous flowers sometimes occur.

3. **Houstonia minima** Beck, in Am. Journ. Sci. 10:262. 1826.

Tiny, tufted annuals; stems erect, 1-7 cm. tall, glabrous; rosette leaves ovate to elliptic, subacute to acute, 5-7 mm. long, 2-5 mm. broad, glabrous and usually scaberulous along the margins; cauline leaves smaller and narrower; petiole 1-3 mm. long, glabrous; peduncles 1-4 cm. long, glabrous or nearly so; bracts resembling the upper cauline leaves; sepals lanceolate to ovate-lanceolate, acute, 2-4 mm. long, glabrous or scaberulous; corolla salverform, deep purple, usually with a dark reddish center (eye), the tube 3-5 mm. long, barely longer than the calyx, glabrous, the flower 3-6 mm. wide; capsule bilobed, flattened, 2-3 mm. wide, slightly longer than broad.

Habitat. — Open woods and fields.

General Range. — Illinois to Kansas south to Texas and Arkansas.

Illinois Range. — Essentially the western counties, although one record from Richland County.

Date of Flowering in Illinois. — April 6 to May 19. — Southern Illinois University, Carbondale.

WATERCRESS IN THE NEW WORLD

PETER S. GREEN

Fifteen years ago Howard and Manton (1946) put on record the existence of both a diploid and tetraploid species of watercress and distinguished them under the names *Nasturtium officinale* R. Br. (diploid, 2n = 32) and *N. uniseriatum* Howard & Manton (allotetraploid, 2n = 64). The following year, Airy Shaw (1948) elucidated the nomenclature and showed that the name *N. microphyllum* Boenn. ex Reichb. should be used for the tetraploid on grounds of priority. Since this date it has become widely accepted that on a world basis *Nasturtium* is not distinguishable generically from *Rorippa* and the names of the watercresses then become *R. nasturtium-aquaticum* (L.) Hayek (*N. officinale* R. Br.) and *R. microphylla* (Boenn.) Hyland, whilst for simplicity of reference the sterile triploid hybrid between the two species has been given the name *R.* × *sterilis* Airy Shaw (Shaw 1951).

Both species are natives of Europe, but both have been introduced into the New World, presumably because of their use and value as a salad. Airy Shaw (1948) first recorded the existence of the tetraploid in Canada and the U. S. A., and Green (1955, p. 297-8) added further New World records and noted the existence in the U. S. A. of the sterile hybrid as well. A recent examination of the material in the Gray and New England Botanical Club Herbaria however, has indicated that watercress is far more widely distributed than had at first been expected, and it became apparent that the two species have not been distinguished in American literature. To take the two major Floras in the north-east: Gleason (1952) continued to describe *Nasturtium* as monotypic in 1952, and the figure he published is clearly that of the diploid species. Fernald (1950), however, distinguished a var. *microphyllum* of *N. officinale*, but it is clear from his description, and from annotations he made on specimens in the two herbaria just mentioned, that whilst his concept of var. *microphyllum* is very close to the tetraploid species it is not entirely coincident, and his figure, labeled as *N. offici-*

nale, shows fruit clearly recognizable as those of *Rorippa microphylla*. In the two handbooks for the identification of North American aquatic plants: Muenscher (1944) has one species, which he calls *N. officinale*, and his illustration is clearly that of the tetraploid. Fassett (1940 and 1957) recognizes four named forms based on vegetative characters but he does not mention the name *microphyllum*. Murley in

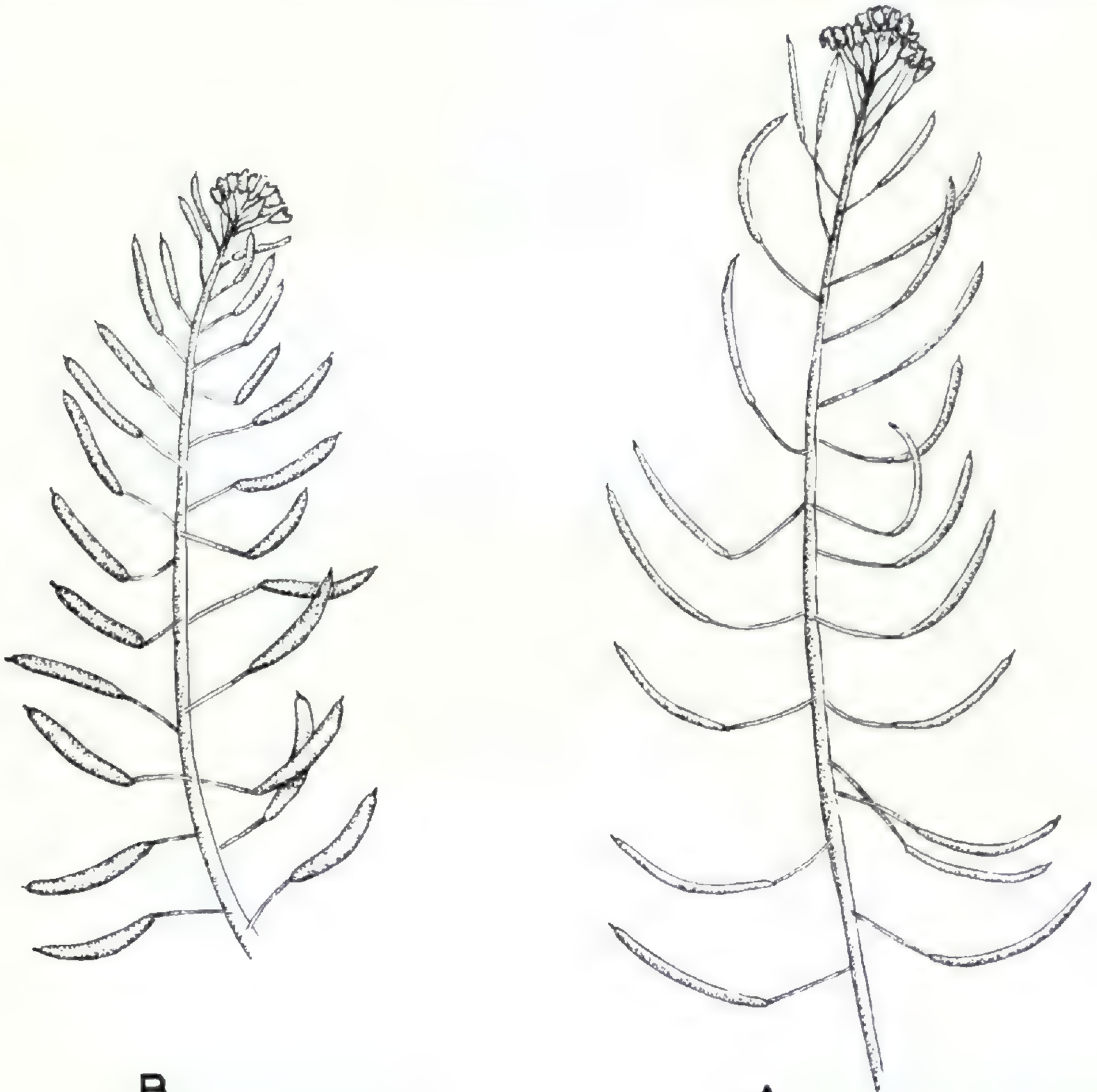

FIG. 1. Fruit and inflorescence of: A, *Rorippa nasturtium-aquaticum* (L.) Hayek; B, *R. microphylla* (Boenn.) Hyland. Half natural size.

her review of the "Seeds of the Cruciferae of North-eastern North America" (1951) only considers the one species, as *Nasturtium officinale*, and gives a beautiful illustration of a seed of the diploid (her fig. 8).

There is no doubt that both *Rorippa nasturtium-aquaticum* and *R. microphylla* are vegetatively both very variable.

For certain and easy distinction it is necessary to use characters of the fruit. In fact, unless the plants are in fruit it is difficult to differentiate between the two species (see Howard & Lyon 1950). In *R. nasturtium-aquaticum* the siliquae are 10-15(-20) mm. long and relatively stout, whereas in *R. microphylla* they are longer, (14-)17-26, mm. long, and more slender (Fig. 1). The fruits are also borne on slightly shorter pedicels in *R. nasturtium-aquaticum* where they are 6-15(-18) mm. long compared with (6-)10-20 mm. in *R. microphylla*. A field character is further provided by the fact that the seeds appear in *R. nasturtium-aquaticum* to

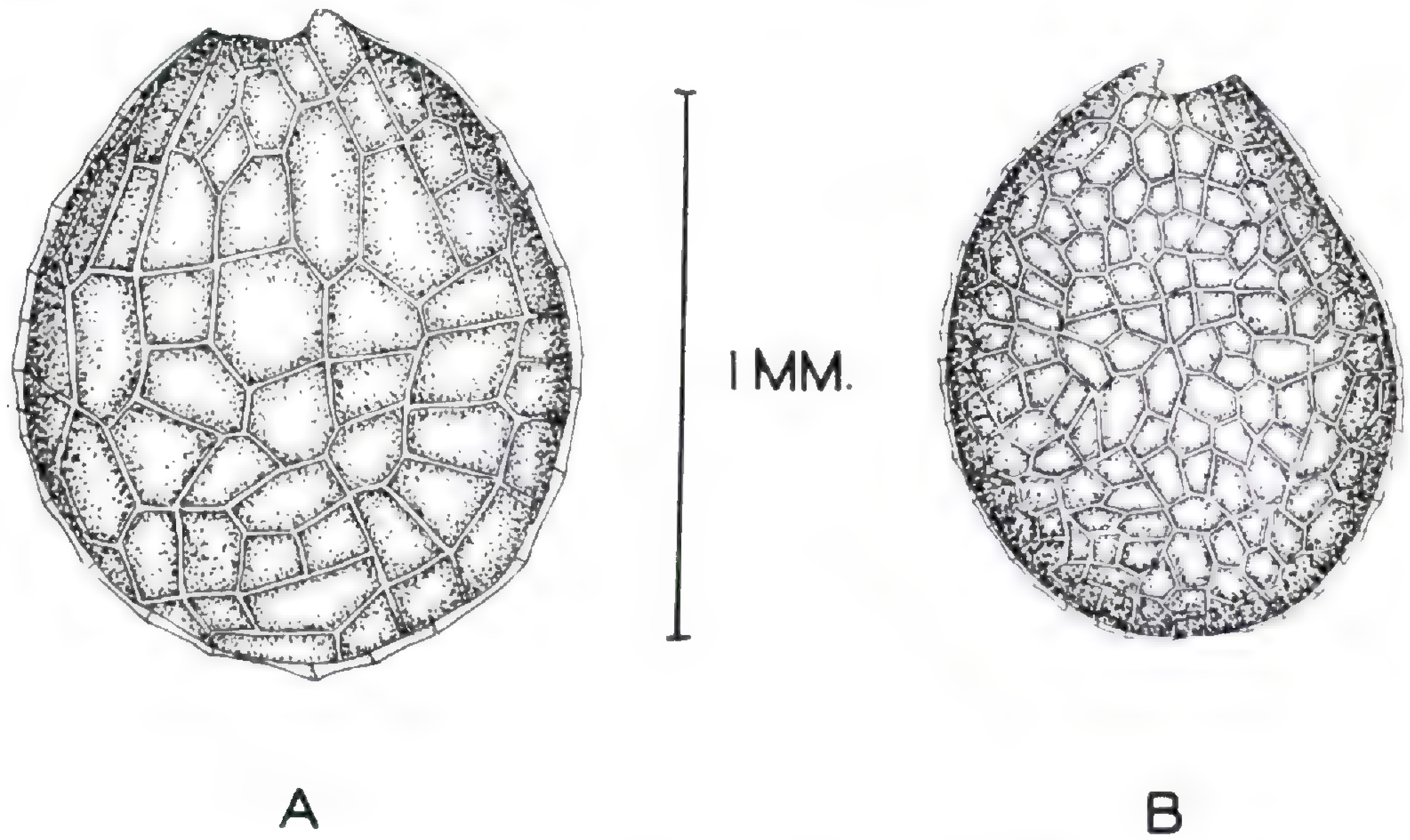

FIG. 2. Individual seed of: A, *Rorippa nasturtium-aquaticum* (L.) Hayek; B, *R. microphylla* (Boenn.) Hyland.

lie in two rows in the pod, whereas in *R. microphylla* they lie in a single row, (hence the epithet *uniseriatum* proposed by Howard & Manton for the tetraploid) but this character has to be used with caution. A character of sure value, however, is provided by the reticulations, or areolae, on the seed coat, which in *R. nasturtium-aquaticum* are large, and number about 35 on any one side of the ripe seed, whilst in *R. microphylla* there are about 150 and these are consequently much smaller (Fig. 2). It is interesting in this connection that a photograph of seeds of *R. nasturtium-aquaticum* is given in one of the plates bound in the center of the 1961 yearbook of

the U. S. Department of Agriculture. If plants to be identified have not reached the fruiting stage then it is possible to distinguish between the species on pollen grain size (Green 1955) and stomatal index (Rowson in Howard & Manton 1946) but the methods are somewhat time consuming.

The hybrid *Rorippa* × *sterilis* is, as its name suggests, easily distinguished by its sterility. The fruits do not develop properly and only an occasional, non-viable, seed is produced. Furthermore, examination of the pollen grains in, for example, a drop of lactic acid, shows that the pollen too is sterile, the grains being very variable in size and the majority of them crumpled and abortive. In fact to be certain of the hybrid it is usually advisable to examine the pollen, for occasional plants of the parental species set little seed from the first flowers to open and, especially in *R. microphylla*, the plant may set very little seed at all if growing under crowded conditions etc.

Because of the variability of vegetative characters the epithet *microphylla* is misleading; leaf shape and size are of no value in distinguishing the species and their hybrid. Large-leaved specimens are found with fruits of *R. microphylla*, and depauperate specimens with small leaves are, as often as not, found to be *R. nasturtium-aquaticum*. A variety *siifolia* has been described within *R. nasturtium-aquaticum* and was recognized by Fernald (1950) along with so-called var. *microphylla*. In it the leaflets are more or less oblong and elongate as opposed to roundish to oval, especially in the case of the terminal leaflet, but such leaves are frequently found in the diploid, tetraploid and hybrid and have no taxonomic significance, at least at the rank of variety.

The distribution of watercress in the U. S. A. and immediately adjacent territories as reflected in the collections of the Gray and New England Botanical Club Herbaria is shown in Fig. 3 (one or two records have been added from a hasty examination of the collections in the herbarium of the New York Botanical Garden made during a recent brief visit). It will be seen that *Rorippa nasturtium-aquaticum* is far more widespread than both *R. microphylla* and the hybrid, which, apart from two records in Idaho and Oregon,

are restricted to eastern Canada and northeastern United States. How many times watercress has been introduced from Europe is unknown, but in view of the esteem in which it has long been held as a salad in England, France and Germany, it is suspected that it has been brought across the Atlantic many times, the first occasion probably having taken place more than 200 years ago. Even from Utah there

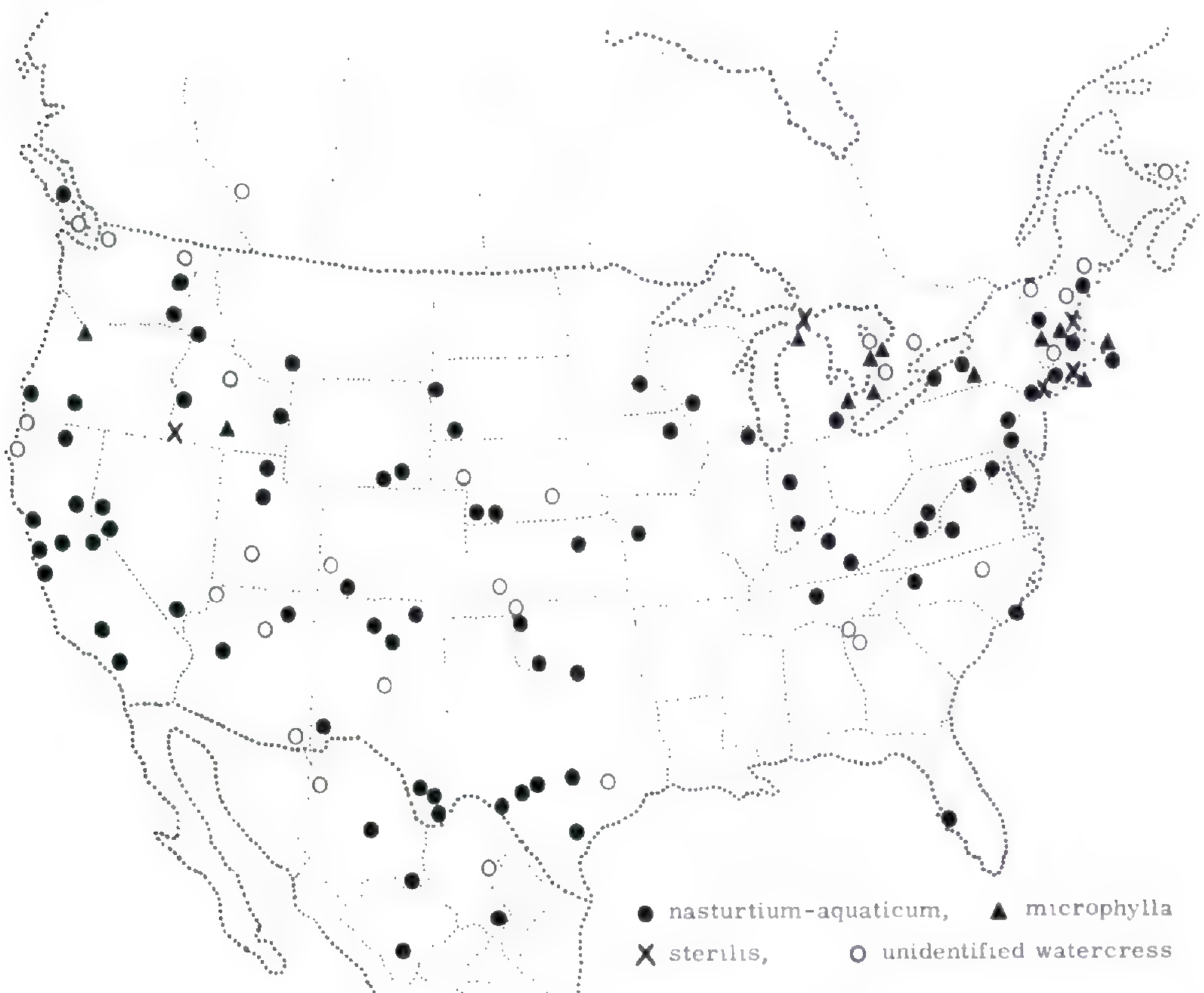

FIG. 3. Distribution map of the watercresses in the U.S.A. and adjacent territories. In the north-east several closely adjacent records may be represented by a single symbol.

is a specimen in the Gray Herbarium collected by E. Palmer as long ago as 1875 which bears a note "introduced from France by J. E. Johnson" and one may believe that the introduction to the eastern states took place long before this, although the earliest specimen I have seen was collected in 1847 from Niagara, New York. The diploid, *R. nasturtium-aquaticum*, is far more widespread than the tetraploid species and is recorded from almost every state. Muenscher (1944) published a map in which it is recorded from every

state but six and I have seen material from three of these six in the course of this investigation. It is debatable whether watercress was intentionally introduced to every state where it now occurs and although it frequently has the appearance of a native plant and is often found remote from any habitation, it must be borne in mind that it commonly grows on muddy stream banks and seed may be relatively easily transported over long distances embedded in mud attached to the feet of birds, and broken portions of the plant can easily be carried down stream once it is established in a particular river or stream. The records of *R. microphylla* and the hybrid in the west almost certainly represent separate introductions and it is not without significance perhaps that at least in recent times the watercresses which are grown commercially in Britain (see Howard 1947) are the diploid, *R. nasturtium-aquaticum*, which is the most widespread introduction, and the hybrid. It is possible too that diploid *R. nasturtium-aquaticum* is more able to flourish in the warmer more southern states, and this is suggested by its distribution outside the United States, whereas the tetraploid is probably the hardier species and the one more able to survive the rigorous winters in the north-east. No doubt the examination of watercress material in other herbaria and the painstaking measurement of pollen grains in material showing only flowers would increase our knowledge of the detailed distribution of the species but it is felt that sufficient indication of the total range is given by the map (fig. 3) and by the citation of the specimens below, to draw the attention of botanists in America to the existence of the two species and how they may be distinguished.

In Central America, the West Indies and South America only material of *Rorippa nasturtium-aquaticum* in the strict sense has been seen. There are three sheets of apparently sterile plants from Cuba in the Gray Herbarium, but examination of the pollen shows that the grains are fully formed and not largely crumpled and abortive as in the hybrid, *R.* × *sterilis*. However, the fruits seem undeveloped and empty, yet in each case the whole plant appears small and the leaves reduced, with few pinnae; it is felt that further comment on

their identity should be reserved until more is known of the conditions under which they were growing. Schulz (1934, p. 41) recorded *Nasturtium officinale* var. *microphyllum* from Chile, but this identification was apparently based on leaf shape alone and in this investigation only the diploid has been seen with certainty from Chile, or for that matter, from the whole of South America.

MATERIAL EXAMINED*

Rorippa nasturtium-aquaticum (L.) Hayek
(*Nasturtium officinale* R. Br.)

CANADA. **British Columbia:** Comox, July 18, 1915, *J. M. Macoun 91854.*

UNITED STATES. **Maine:** Cumberland Co., Yarmouthville, Yarmouth, Aug. 1904, *Kate Furbish* (NEBC). **Vermont:** Rutland Co., Rutland, June 15, 1892, *Willard W. Eggleston 1.* **Massachusetts:** Berkshire Co., Pittsfield, Sept. 23, 1899, *R. Hoffmann;* Norfolk Co., Dedham, Purgatory Swamp, June 27, 1897, *J. M. Greenman 260;* Nantucket Co., Nantucket, Polpis, June 1, 1900, *M. A. Day 2* (GH, NEBC). **Rhode Island:** Newport Co., Block Island, June 24, 1917, *R. P. Marshall* (NEBC). **Connecticut:** Fairfield Co., Bridgeport, June 3, 1902, *E. H. Eames* (NEBC); Hartford Co., Southington, June 30, 1898, *L. Andrews 311;* Litchfield Co., Woodbury, June 12, 1909, *E. B. Harger 5548* (NEBC); New Haven Co., North Branford, Aug. 5, 1914, *E. B. Harger 6415* (NEBC); New London Co., Franklin, June 18, 29, 1915, *R. W. Woodward.* **New York:** Niagara Co., Niagara Falls near Table Rock, June 1847, *John A. Lowell;* Wayne Co., Newark, Aug. 31, 1872, *E. L. Hankenson.* **Pennsylvania:** Berks Co., Hamburg, July 19, 1892, *C. D. Lippincott;* Chester Co., 1858-1864, *S. P. Sharples;* Lebanon Co., Miners Village, May 30, 1889, *A. A. Heller.* **Delaware:** New Castle Co., Centreville, May 20, 1865, *A. Commons.* **Maryland:** Montgomery Co., shores of Potomac, June 6, 1881, *John Donnell Smith.* **W. Virginia:** Munroe Co., Sweet Springs, Sept. 15, 1903, *E. S. and Mrs. Steele 315;* Pocahontas Co., Minnehaha Spring, July 31, 1930, *W. V. U. Botanical Exped.* **Virginia:** Botetourt Co., E. Buchanan, along the Otter Rd., May 17, 1892, *John K. Small;* Page Co., Luray, Stony Man Mountain and vicinity in the Blue Ridge, Aug. 12, 1901, *E. S. and Mrs. Steele 161.* **North Carolina:** Avery Co., Cranberry, on US 19E, June 17, 1958, *Harry E. Ahles & J. A. Duke 43572;* New Hanover Co., Carolina Beach, April 18, 1938, *R. K. Godfrey & M. F. Buell 3542.* **Florida:** Sarasota Co., Sarasota, March 31, 1943, *Anne E. Perkins.* **Michigan:** Washtenaw Co., edge of Fleming Creek, 4¾ mi. east of Ann Arbor, *F. J. Hermann 6950.* **Ohio:** Portage Co., Garrettsville, July 18, 1896, *R. J. Webb 156.* **Indiana:** Tippecanoe Co., 0.5 mi. s.w. of Lafayette, west

*Specimens in the Gray Herbarium unless otherwise stated.

bank of Wabash River valley, June 2, 1945, *Ray C. Friesner 18859.* **Kentucky:** Jefferson Co., near Beuchel, July 5, 1939, *M. Seargent 49;* Wayne Co., Beaver Creek, s.w. of Monticello, July 12-14, 1937, *L. B. Smith & A. R. Hodgdon 3868.* **Tennessee:** Davidson Co., Nashville, June 14, 1960, *Howard S. Gentry 18589.* **Wisconsin:** LaCrosse Co., Bohemian Creek, *Thomas A. Hartley 778* (NY). **Illinois:** Kane Co., Elgin, June 9, 1911, *Earl E. Sherff;* McHenry Co., McHenry, June 25, 1860, *George Vasey 2105.* **Minnesota:** Dakota Co., railroad near Nicols, Sept. 19, 1941, *J. W. Moore, E. K. Butters & D. Jenkins 15113.* **Iowa:** Fayette Co., Fayette, Aug. 1894, *B. Fink.* **Missouri:** Clay Co., Randolph, June 20, 1897, *Kenneth K. MacKenzie* (NY). **South Dakota:** Fall River Co., Black Hills, Hot Springs, June 14, 1892, *P. A. Rydberg 531.* **Nebraska:** Dundy Co., Rock Creek Park, Aug. 3, 1945, *Walter Kiener 19417;* Redwillow Co., 8 miles west of McCook, July 31, 1945, *Walter Kiener 19411.* **Kansas:** Riley Co., 1896, *J. B. Norton 613.* **Oklahoma:** Carter Co., between Ardmore and Springer, April 29, 1961, *Reed C. Rollins 61156;* Comanche Co., Fort Sill, June 16, 1916, *Mrs. J. Clemens 11601;* Ellis Co., on edge of Wolf Creek near Shattuck, June 10, 1914, *R. L. Clifton 3200K;* Love Co., 2 miles s.w. of Bomar, June 23, 1953, *G. J. Goodman & E. L. Rice 5686.* **Texas:** Brewster Co., Leoncita Springs, Kokernot ranch, April 30, 1948, *Barton H. Warnock & F. M. Churchill 7725;* Gonzales Co., Cottonwood Springs, April 16, 1934, *V. L. Cory 8271;* Jeff Davis Co., Limpia Canyon 10 miles north of Ft. Davis, June 13, 1941, *R. R. Innes & Brunelle Moon 1095;* Kerr Co., Kerrville, May 14-21, 1894, *A. A. Heller 1753;* Real Co., Prade Ranch, headwaters of Rio Frio, April 18, 1959, *R. C. Rollins & D. S. Correll 5940;* Travis Co., Austin, May 15, 1872, *Elihu Hall 14;* Valverde Co., along the Rio Grande from Brownsville to El Paso, Devil's River, April 20, 1919, *H. C. Hanson 523.* **Montana:** Gallatin Co., Bozeman, July 10, 1902, *W. W. Jones.* **Idaho:** Ada Co., Boise, Aug. 19, 1911, *June A. Clark 257;* Canyon Co., Falk's Store, July 7, 1910, *J. F. Macbride 327;* Teton Co., Victor, July 11, 1901, *E. D. Merrill & E. N. Wilcox 1015;* Nez Perce Co., Upper Ferry, above Lewiston, Clearwater River, June 2, 1892, *J. H. Sandberg, D. T. MacDougal & A. A. Heller 298.* **Wyoming:** Albany Co., Laramie, Sept. 30, 1984, *Aven Nelson 1152;* Crook Co., Sand Creek near Beulah, June 21, 1950, *C. L. Porter 5349;* Platte Co., Sibyllee Creek, July 18, 1945, *C. L. Porter 3692.* **Colorado:** La Plata Co., T. 34 N., R. 8 W., Aug. 14, 1937, *Marion Ownbey 1439.* **Utah:** Cache Co., half mile west of Logan, July 30, 1940, *Bassett Maguire 20099;* Salt Lake Co., Salt Lake City, 1869, *Sereno Watson 6;* Utah Co., Spring Lake, 1875, *E. Palmer.* **Nevada:** Clark Co., Willow Springs, Aug. 6, 1935, *I. W. Clokey 5481;* Mineral Co., Corey Canon. Wassuk Mts., June 27, 1919, *Ivar Tidestrom 10084;* Ormsby Co., King's Canon, June 11, 1902, *C. F. Baker 1057.* **New Mexico:** Colfax Co., vincinty of Ute Park, Sept. 10, 1916, *Paul C. Standley 14611;* Grant Co., Fort Bayard Watershed, Stephen's Ranch, Oct. 22, 1905, *J. C. Blumer 112;* San Miguel Co., near Pecos, Aug. 20,

1908, *Paul C. Standley 5129;* Sierra Co., Berendo Creek, May 20, 1904, *O. B. Metcalfe 907;* Socorro Co., Mogollon Mts., on or near the west fork of the Gila River, Aug. 25, 1903, *O. B. Metcalfe 606.* **Arizona:** Coconino Co., Painted Desert, Tuba Oasis, July 15-20, 1920, *W. N. Clute 107;* Yavapai Co., 6 miles east of Prescott, June 29, 1928, *Carl B. Wolf 2375.* **California:** Inyo Co., White Mts., Roberts Ranch, Wyman Creek, July 21, 1931, *Victor Duran 3140;* Los Angeles Co., Claremont, May 28, 1910, *J. D. Taylor 133;* Marin Co., Tomales Point, one mile west of Indian Beach, May 24, 1941; *H. L. Mason 12424;* Mono Co., Lakeview Spring, 6.5 miles from Bridgeport-Sweetwater Highway, Aug. 3, 1945, *Ira L. Wiggins & R. C. Rollins 546;* Monterey Co., Pacific Grove, July 1, 1905, *C. P. Smith 1005;* Riverside Co.; Santa Anna River at Chino Creek, May 28, 1933, *L. C. Wheeler 1747;* Santa Clara Co., Palo Alto estate, May 4, 1894; Siskiyou Co., near the Box Canyon of the Sacramento near Mt. Shasta City, July 12, 1940, *W. B. Cooke 15321;* Stanislaus Co., Modesto, July 13, 1935, *R. F. Hoover 686.* **Oregon:** Curry Co., Port Orford near Battle Rock, June 4, 1928, *J. W. Thompson 4480;* Klamath Co., near Ft. Klamath, Aug. 7, 1894, *J. B. Leiberg 665.* **Washington:** Spokane Co., Clark Springs, Spokane, July 8, 1902, *F. O. Kreager 124;* Walla Walla Co., Waitsburg, May 25, 1897, *R. M. Horner B54;* Whitman Co., Wawawai, June 4, 1892, *Lake & Hull 477.* **Alaska:** Manley Hot Springs, near the Tanana River, Sept. 15-19, 1949, *Edith Scamman 5798.*

MEXICO: **Chihuahua:** vicinity of Chihuahua, May 1-21, 1908, *Edward Palmer 184.* **Coahuila:** Saltillo, June 1898, *Edw. Palmer 223;* **Durango:** Durango, July 25, 1944, *C. V. Morton 44191.* **Hidalgo:** Pachuca, near Zerezo and below Parque Nacional El Chico, May 12, 1947, *H. E. Moore 2793.* **Jalisco:** Guadalajara, May 15, 1901, *C. G. Pringle 8494.* **Michoacan:** Zitácuaro, Sept. 5, 1935, *Geo. B. Hinton et al. 11848.* **Mexico:** Vallee de Mexico, June 4, 1865-6, *Bourgeau 18.* **Puebla:** Huauchinango, sand along Rio Necaxa, March 27, 1945, *A. J. Sharp 45369.*

CUBA. Santa Clara Prov., Mina Carlota, southeast of Cumanayagua, Sierra de San Juan, March 21-23, 1938, *H. A. Senn 332.* Oriente Prov., 1856-1857, *C. Wright 7.*

HAITI. San Michel to Marmelade, Aug. 6, 1905, *George V. Nash & Norman Taylor 1472* (NY).

DOMINICA. Prov. San Juan, El Cercado, Juan Santiago, Hondo Valle, Sept. 1, 1946, *R. A. & E. S. Howard 8743.*

PUERTO RICO. Adjuntas, in mont "Cienega", April 11, 1886, *P. Sintenis 4116.*

VENEZUELA. Near Tovar, 1854-1855, *A. Fendler 20.*

COLOMBIA. Dept. of Cundinamarca, Bogota, Oct. 4-8, 1917, *Francis W. Pennell 2348.*

ECUADOR, Prov. Canar, near village of San Marcos, Azogues, April 1, 1945, *Francisco Prieto E2479.* Prov. Chimborazo, Canon of the rio Chanchan near Huigra, May 7-14, 1945, *W. H. Camp E3153.*

PERU. Dept. Lima, Prov. Chancay near Supe, Sept. 4, 1938, *Alan A. Beetle & O. B. Horton 9064*. Dept. of Cusco, Pisac, April 30, 1925, *Francis W. Pennell 13718*. Dept. of Junin, Oroya, 1919, *Margaret Kalenborn 60*.

CHILE. Prov. Aconcagua, Valle de Marga-Marga, 1930-32, *Felix Jaffuel & Anastasio Pirion 3265*. Prov. Atacama, Dept. Copiapó, vicinity of Copiapó, Nov. 16, 1925, *Ivan M. Johnston 4992*. Prov. Coquimbo, Dept. Elqui, El Colorada, 70 km. on road from Rivadavia to Laguna, tributary dam of Laguna River, Feb. 16, 1940, *R. Wagenknecht 18501*. Prov. Osorno, Puerto Octay, A orillas del lago Llanquihue, Nov. 29, 1939, *Hugo Gunckel 9323*. Prov. Santiago, Penalobu, Jan. 2, 1927, *G. Looser 79*. Prov. Valdivia, Rinihue, Feb. 12, 1933, *Hugo Gunckel 5821*.

BRAZIL. S. Leopoldo, Oct. 1940, *J. Eugenio Leite 1794*. S. Rosa, Sombrie, S. Catarina, Oct. 11, 1944, *R. Reitz C767*.

BOLIVIA. Dept. Cochabamba, Cuidad de Cochabamba garten, Dec. 26, 1928, *José Steinbach 8788*. Dept. La Paz, La Paz, Oct. 10, 1921, *Otto Buchtien 244*.

URUGUAY. Dept. Motevideo, Cerro Casabo, Sept. 1926, *G. Herter 443 (80926)*.

ARGENTINA. Prov. Buenos Aires, Partido de Tornquist, Sierra de la Ventana, Albra de la Ventana, Nov. 7, 1938, *A. L. Cabrera 4693*. Prov. de Cordoba, Unquillo, 1926, *C. Bruch*. Prov. of Tucuman: Dept. Famaillá, Rio Colorado, Sept. 1919, *S. Venturi 415*. Terr. de Rio Negro, Region del Lago Nahuel Huapi, Basiloche, Feb. 5, 1940, *A. L. Cabrera 5965*.

Rorippa microphylla (Boenn.) Hyland. (*Nasturtium microphyllum* (Boenn.) Reichb., *N. uniseriatum* Howard & Manton)

CANADA. **Newfoundland:** Waterford River between Waterford Bridge and St. John's, Aug. 1, 1911, *M. L. Fernald & K. M. Wiegand 5482*. **Ontario:** Simcoe Co., Collingwood, Baie Georgienne, Aug. 26, 1933, *F. Marie-Victorin, F. Rolland-Germain, & René Meilleur 45069;* Bruce Co., Mouth of Pine River, 6 mi. south of Kincardin, L. Huron, June 19, 1948, *J. H. Soper & H. M. Dale 3952*.

UNITED STATES. **New Hampshire:** Strafford Co., along Oyster River, near Northwood-Durham turnpike, July 4, 1943, *A. R. Hodgdon 4565* (NEBC). **Vermont:** Bennington Co., Arlington, July 3-4, 1903, *W. W. Eggleston 3229* (NY). **Massachusetts:** Barnstable Co., Harwich, the head of Allen's Harbor Creek, Aug. 6, 1919, *M. L. Fernald & Bayard Long 18502;* Berkshire Co., North Adams, June 25, 1913, *M. L. Fernald & Bayard Long 9553* (GH, NEBC); Essex Co., Newburyport, "The Gully", July 31, 1940, *R. C. Bean* (NEBC); Franklin Co., Greenfield, July 25, 1911, *C. H. Knowlton* (NEBC); Middlesex Co., Waltham, 1861, *Wm. Boott;* Norfolk Co., Wrentham, near north end Archers Pond, Sept. 18, 1897, *F. G. Floyd 374* (NEBC); Plymouth Co., West Hingham, July 25, 1888, *Walter Deane* (NEBC); Suffolk Co., Jamaica Plain, Arnold Arboretum, Bussey Brook, June 27, 1927, *E. J.*

Palmer 28003 (A). **Rhode Island:** Providence Co., Goosenest Brook, Wickford Junction, July 31, 1909, *Thomas Hope* (NEBC). **New York:** Tompkins Co., Ithaca, Dwyer's Pond, July 29, 1913, *E. L. Palmer 564;* Cortland Co., Inlet to Mud Pond, McLean Wild Life Preserve, July 29, 1932, *W. C. Muenscher 17921.* **Michigan:** Emmett Co., Pickerel Lake, east of Petoskey, July 6, 1933, *H. A. Gleason 100.* **Idaho:** Blaine Co., Picabo, July 3, 1916, *J. F. Macbride & Edwin B. Payson 3009.* **Oregon:** Hood River, May 28 & July 1885, *W. N. Suksdorf 506.*

Rorippa × sterilis Airy Shaw

(Rorippa microphylla × R. nasturtium-aquaticum)

UNITED STATES. **New Hampshire:** Strafford Co., Durham, near Madbury Line, Aug. 1, 1943, *A. R. Hodgdon 4569* (NEBC). **Connecticut:** Fairfield Co., Bridgeport, June 19, 1896, *E. H. Eames;* Hartford Co., East Hartford, June 3, 1893, *C. A. Weatherby* (NEBC); New Haven Co., Oxford, July 21, 1896, *E. B. Harger 200* (NEBC). **Michigan:** Mackinac Co., Mackinac Island, July 30, 1924, *F. W. Hunnewell 9308.* **Idaho:** Owyhee Co., Flint Creek, July 30, 1910, *J. F. Macbride 492.*

Two final comments are thought to be of value. Airy Shaw (1948) recorded *R. microphylla* from California, however, he considered both of the records he gave to be doubtful, and one, based on *Copeland 368* from Jonesville, Butte Co., was found (Green, 1955) on examination of the pollen grains not to be a watercress at all. Examination of a duplicate of this in the Gray Herbarium, and comparison there with the extensive collections from North America shows that it is a rather depauperate specimen of *Cardamine breweri* S. Wats.

Finally, whilst not strictly concerning the watercresses of the New World, the opportunity was taken to examine the material in the Gray Herbarium from Japan. Previous examination of Japanese material (Green, 1955) in the herbaria at Edinburgh and Kew showed all the flowering specimens to be *R.* × *sterilis* alone. Three further collections in the Gray Herbarium have now been seen and they too are each of them the hybrid. (Hondo: June 2, 1929, *K. Shiota 1044;* May 19, 1935, *K. Shiota 8437.* Shikoku: June 2, 1935, *I. Yogo 9557*). It is interesting to see, however, that Kitamura and Murata (1961) list *Nasturtium officinale* R. Br. and illustrate (their fig. 86 (i)) a typical fruit of the diploid; their coloured illustration (plate 42) however, shows only flowers and has no fruits. — ARNOLD ARBORETUM OF HARVARD UNIVERSITY.

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A NEW SPECIES OF SCIRPUS IN THE NORTHEASTERN UNITED STATES

ALFRED E. SCHUYLER

While collecting leafy species of *Scirpus* in the Connecticut River valley through Vermont, Massachusetts, and Connecticut during the summer of 1960, I was surprised to find a population of plants which did not conform to any descriptions in the standard manuals for this region (Fernald, 1950; Gleason, 1952). Vegetatively the plants appeared very similar to *Scirpus atrovirens* Willd., which is widespread in eastern North America. However, an examination of the comparatively large achenes and rigid perianth bristles revealed some striking differences from *S. atrovirens*, and later, other differences were discovered. Also, more specimens of this taxon were found in herbarium folders containing specimens of *S. atrovirens* and its relative, *S. polyphyllus* Vahl.[1] Because of its well-marked distinctions from previously recognized species of *Scirpus*, I herein describe it as a new species.

[1]I am indebted to the curators of the following herbaria where I visited or obtained loans: Gray Herbarium, University of Massachusetts, Dartmouth College, New York State Museum, Wiegand Herbarium, New York Botanical Garden, Pennsylvania State University, Philadelphia Academy of Natural Sciences, U. S. National Museum, University of Michigan, and Missouri Botanical Garden.

Scirpus ancistrochaetus sp. nov.

Culmi 0.8-1.2 m. alti, foliis inferioribus usque ad 8 mm. (10 mm.) latis. Spiculae glomeratae; squamae spicularum vix mucronatae, illis medianis 1.55-1.90 mm. longis. Setae 6, 1.1-1.7 mm. longae, rigidae, fere usque ad basim dentibus retrorsis crassis acribus armatae. Fructus 1.10-1.35 mm. longi, fere omnes obovati, parte supra cavum seminis lenta et crassa.

Plants perennial, producing flowering culms from short, woody, underground rhizomes; lateral buds of the rhizome producing erect shoots which break through the subtending leaf sheaths. Flowering culms 0.8-1.2 m. tall; *lower leaves up to 8 mm. (rarely 10 mm.) wide, 40-60 times as long as wide;* uppermost leaf 3-5 mm. in width, 30-50 times as long as wide; lowermost involucral bract 3-5 mm. in width, 5.5-17.0 cm. in length. Inflorescence rays up to 6.3 cm. long, bearing clusters of brown spikelets. *Scales slightly mucronate, those from the central portion of the spikelet 1.55-1.90 mm. long. Bristles 6, 1.1-1.7 mm. long, rigid, armed almost to the base with thick-walled, sharp-pointed, retrorse teeth.* Stamen number variable, between 0 and 3. Styles 3-parted, up to 1.35 mm. long. *Fruits yellow-brown, 1.10-1.35 mm. long, mostly obovate, the portion above the seed cavity tough and thickened.* "Oil layer" of the seed with cell walls inconspicuous as a result of abundant pits.

TYPE LOCALITY: VERMONT: Windham Co.: 5 mi. n. of Bellows Falls, e. side of rt. 5, small population along margin of pool, July 3, 1960, *A. E. Schuyler 3051* (MICH, type); Aug. 11, 1960, *A. E. Schuyler 3298* (MICH); Aug. 12, 1961, *A. E. Schuyler 3445* (MICH).

ADDITIONAL LOCALITIES: PENNSYLVANIA: Lackawanna Co.: ¾ mi. w. of Fleetville, east of Lake Kewanee (Windfall Pond), clump in mud-hole on margin of wet woods, July 29, 1946, *S. L. Glowenke 8052* (NYS, PAC). [Lackawanna Co.?:] Near Carbondale, Mud Creek, Aug. 1, 1897, *D. L. Topping* (US). Blair Co.: Bald Eagle Valley, 1865, *J. R. Lowrie* (PAC).[2]

Vegetatively *S. ancistrochaetus* may be distinguished from *S. atrovirens* by its narrower leaves, more ascending inflorescence rays, and larger, slightly mucronate scales. The flowers of *S. ancistrochaetus* have 6 perianth bristles which are rigid and barbed almost to the base with thick-walled, sharp-pointed, retrorse teeth; flowers of *S. atrovirens* have a variable number of perianth bristles (usually 4-6) which are delicate and often wrinkled, and the thin-walled, round-tipped, retrorse teeth are concentrated

[2]After submitting this manuscript, I found a specimen of *S. ancistrochaetus* from New York State: Washington Co.: W. Ft. Ann, Mt. Nebo, 1800 ft., wet place, Sept. 13, 1900, *S. H. Burnham* (CU).

PLATE 1266. Type specimen of *Scirpus ancistrochaetus*.

toward the tip of the bristle. The achenes of *S. ancistrochaetus* are about 1.25 mm. long and the portion above the locule is tough and thickened; achenes of *S. atrovirens* are about 1 mm. long and lack a tough, thickened portion above the locule. Some of these characteristics of *S. ancistrochaetus* and *S. atrovirens* are illustrated in figure 1.

Scirpus polyphyllus and *S. ancistrochaetus* have achenes which are almost the same length, but those of *S. polyphyllus* tend to be wider and less obovate. Also, *S. polyphyllus* may be distinguished from *S. ancistrochaetus* by its more mucronate scales and longer, more delicate bristles.

The bristles of *S. ancistrochaetus* are almost identical with those of *S. sylvaticus* L. of the Old World and its North American counterpart, *S. expansus* Fern. However, these species are easily distinguished from *S. ancistrochaetus* by their wider leaves, more branched inflorescences, blacker scales, and three-angled achenes. Many of the cells outside of the midrib in the scales of *S. ancistrochaetus* contain an orange pigment while these same cells in the scales of *S. sylvaticus* and *S. expansus* either contain a black pigment or lack pigment altogether. The achenes of *S. ancistrochaetus* are more plano-convex, with the dorsal angle not very conspicuous.

Some other interesting specimens have been turned up which appear to be robust forms of *S. ancistrochaetus*. Superficially the seeds appear to be normal, but closer examination reveals that they do not contain an embryo or an endosperm. A cytological examination of meiosis might prove very useful in ascertaining the relationship of this type to typical *S. ancistrochaetus*. It is known only from one locality: PENNSYLVANIA: Clinton Co.: 4 mi. n. of Loganton, in bog, Sept. 13, 1940, *H. A. Wahl 876* (GH, CU).

Hybrids between *S. ancistrochaetus* and *S. atrovirens* are morphologically intermediate between the two parents and have abortive seeds. Some of their characteristics are illustrated in figure 1, between those of the two parents. The criteria of assessing the hybrid nature of these plants are quite similar to those found in the study of *S. peckii* (Schuyler, 1961). Hybrids have been found in two localities: VER-

MONT: Windham Co.: 5 mi. n. of Bellows Falls, e. side of rt. 5, growing between populations of *S. ancistrochaetus* and *S. atrovirens* along margin of pool, Aug. 12, 1961, *A. E. Schuyler 3453* (MICH). PENNSYLVANIA: Centre Co.: 3½ mi. s. of State College, Musser's Gap, June 13, 1914, *A. R. Bechtel* (PAC).

The distribution of *S. ancistrochaetus* and its hybrid with *S. atrovirens* in Pennsylvania (see figure 2) appears to be correlated with the western limits of the ridge and valley region. Some localities (Bald Eagle Valley and the Connecticut River valley) indicate that this species may occur primarily in lowland habitats in hilly country. The habitats, themselves, appear to be wetter than those of *S. atrovirens*.

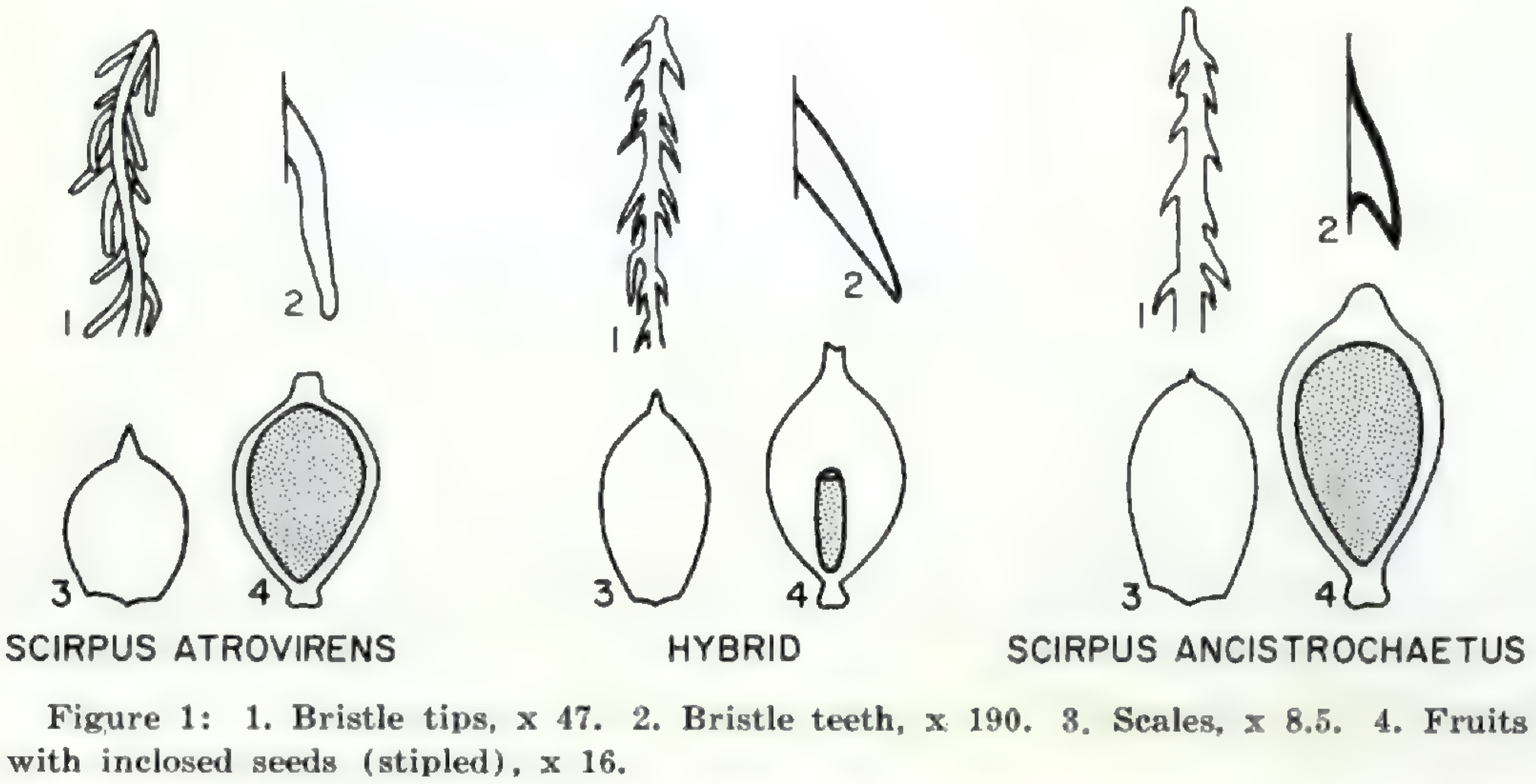

Figure 1: 1. Bristle tips, x 47. 2. Bristle teeth, x 190. 3. Scales, x 8.5. 4. Fruits with inclosed seeds (stipled), x 16.

In the Vermont locality, *S. ancistrochaetus* occurs along the margin of a pool and *S. atrovirens* occurs a short distance away from the margin. Herbarium labels on the Pennsylvania specimens also suggest a wetter habitat.

Because of the floristic affinity between Asia and North America in the genus *Scirpus* (Raymond, 1959), it was considered possible that *S. ancistrochaetus* also occurs in Asia. However, neither Koyama (1958) nor Raymond (1957, 1959) has mentioned or described any plants closely resembling *S. ancistrochaetus*.

The occurrence of *S. ancistrochaetus* in isolated localities in a region where the flora is relatively well known suggests that it may be a relict species. It is possible that in regions

where it does not now exist, it has made a permanent imprint on our flora through hybridization. For example, even though the F_1 hybrids with *S. atrovirens* that I have discovered appear to be highly sterile, the possibility still remains that some individuals may be partially fertile and backcross with either parent. The backcross individuals may be extremely rare and quite sterile, but fertility may be

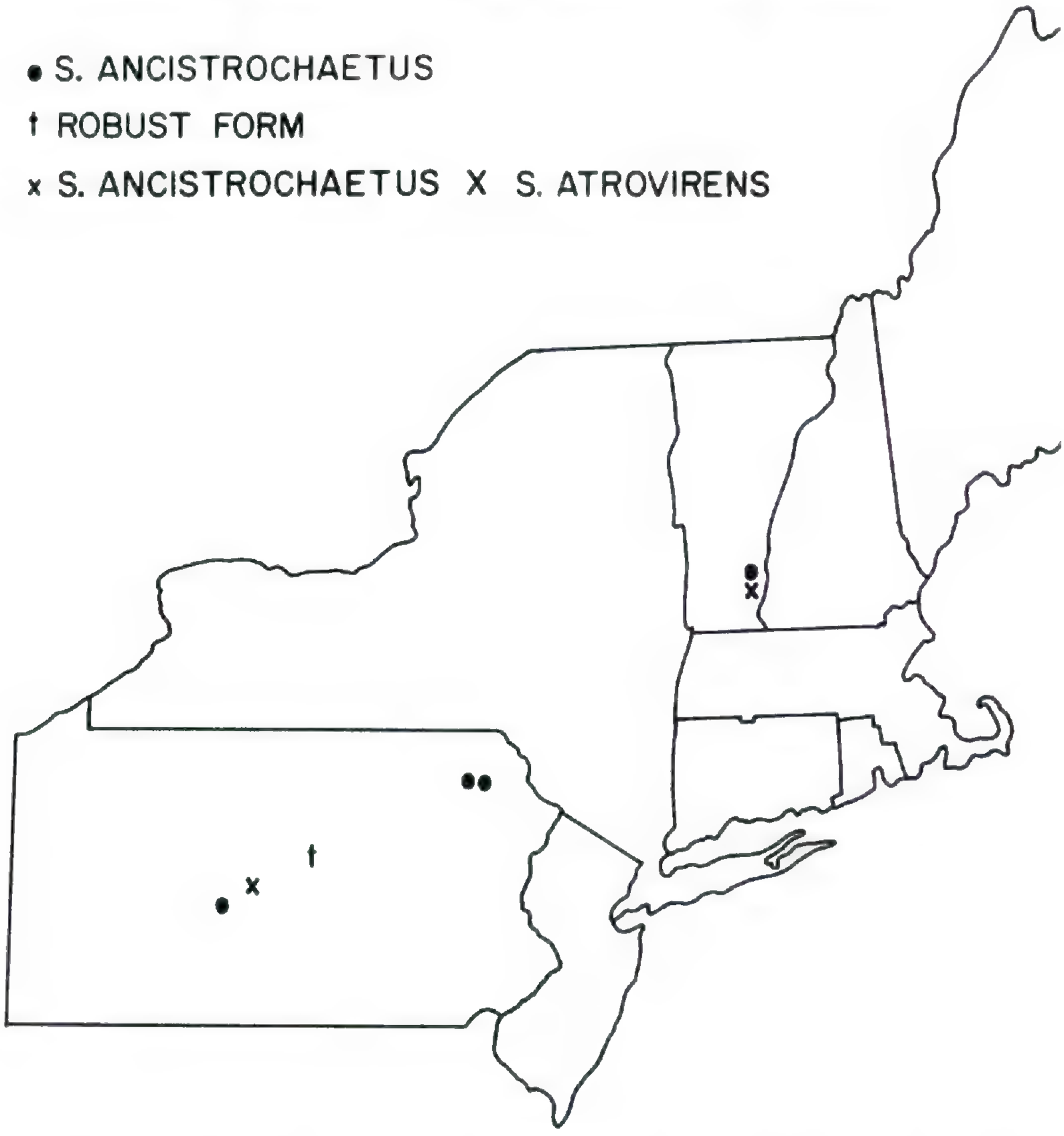

FIGURE 2: Distribution of *Scirpus ancistrochaetus*, including its robust form and its hybrid with *Scirpus atrovirens*.

gradually restored as the backcross individuals acquire more and more genes from one of the original parents, in this case *S. atrovirens*. These fertile individuals which result from backcrossing would make this original parent appear more polymorphic. I think that most taxonomists would agree

that *S. atrovirens* is morphologically variable; and Hicks (1928) has indicated that there is also substantial cytological variability. Some of this variability could be due to past hybridization of *S. atrovirens* with *S. ancistrochaetus*. — DEPARTMENT OF BOTANY, UNIVERSITY OF MICHIGAN, ANN ARBOR.

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A SURVEY OF THE ALGAE OF LAKE QUINSIGAMOND[1]

TANG SHIH-CHEN AUYANG[2]

This study of the fresh water algae of Lake Quinsigamond, Worcester, Massachusetts, was undertaken in order to identify the species, to investigate their distribution, and to compare the results with those of G. E. Stone in his paper "Flora of Lake Quinsigamond" published in 1900.

Stone listed 81 genera and 331 species of algae, excluding Diatoms, in his paper; the Desmids (including placoderm and saccoderm types) were the largest group, totalling 150

[1]Portion of a thesis submitted to the Department of Biology, Clark University, in partial fulfillment of requirements for the degree of Master of Arts. The thesis was undertaken under the direction of Dr. Vernon Ahmadjian.

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species. The author found 86 genera and 217 species of algae, excluding Diatoms, in which only 66 species of Desmids were found. This great difference in the number of Desmid species can be explained possibly by the fact that external environment factors have changed during the past 60 years, and have inhibited the growth of these algae.

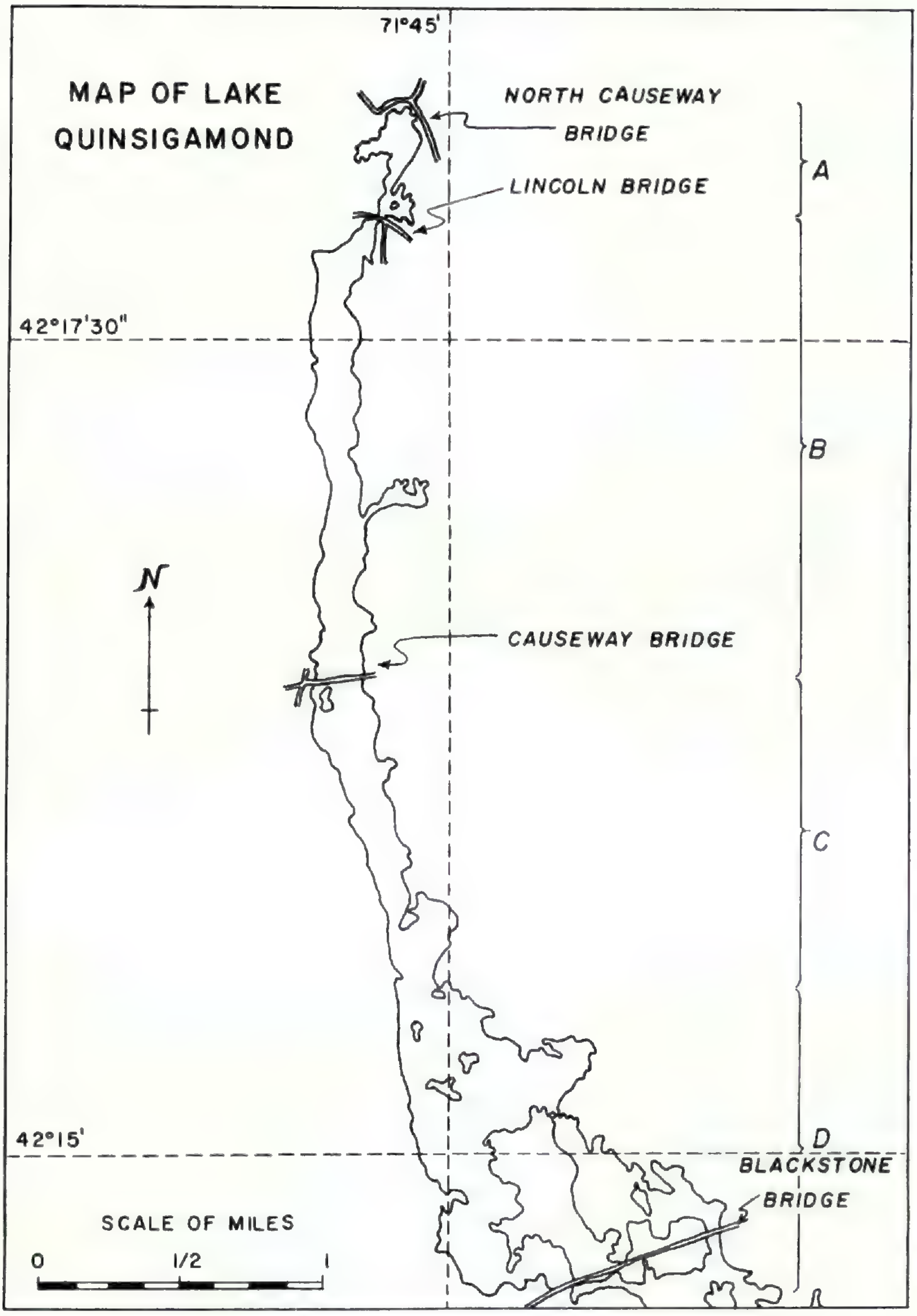
Probably as a result of these environmental changes, the author was not successful in collecting any species of *Chara* and *Nitella*, of which Stone found 5 and 6 species, respectively. On the other hand, tremendous quantities of *Hydrodictyon*, which was not listed in Stone's paper, were found by the author.

Thirty-nine genera listed by Stone were identified by the author. However, 42 genera which Stone found were not found by the author, while 47 genera, excluding Diatoms, not listed by Stone were collected and identified by the author. These figures show that the algal flora of Lake Quinsigamond has changed greatly due to factors which will require more detailed investigation by future workers.

The lake was described by Stone as follows: "Lake Quinsigamond which is situated near Worcester is one of the largest lakes in Massachusetts, and is about six miles long, hardly exceeding one-half mile in width, although in many places it is from fifty to one hundred feet or more in depth. It runs in a northerly and southerly direction along the edge of one of the geological dividing lines of the State which separates the central highlands from the less elevated areas of our seaboard. The immediate surroundings on the lake consist geologically of sand and gravel and probably the greater portion of the basin itself is made up of this material, over which there is spread a considerable mass of decomposed matter, the results of centuries of vegetable and animal decay. While a considerable portion of the basin of the lake is too deep to give rise to much vegetable life, there are vast areas of shallow water which are especially adapted to a profusion of vegetable forms, thus making it one of the best collecting grounds in Massachusetts."

PROCEDURE — The field work for this thesis started in

January, 1960. At that time, except for the northern inlet from which water flows into the lake, the whole lake was frozen with seven inches of ice covered with knee-deep



snow. In the beginning of April, ice on the lake gradually started to melt from north to south. By April, 5th, all of the ice had melted completely. While the lake was frozen, algae were collected within the limits of the northern inlet and samples were taken from a hole about 2 ft. in diameter dug through the ice in the middle of the lake. During the warmer, ice-free months, collections were made periodically either by walking along the lake shore or using a boat to travel to various parts of the lake.

DISTRIBUTION — Lake Quinsigamond can easily be divided into sections with the aid of four bridges; naming them from north to south, they are North Causeway Bridge, Lincoln Bridge, Causeway Bridge and Blackstone Bridge (Fig. 1).

1). At the North Causeway Bridge, *Draparnaldia* was very abundant. The water there was clear and running and its temperature was about 1.5 C° when collections were made. *Draparnaldia* was found attached to small stones under the bridge. In the quiet water near the shore many specimens of *Tetraspora* were found. Planktonic collections in this area contained large numbers of desmids, diatoms and several species of *Pediastrum* in early spring.

2). Under Lincoln Bridge there were a few big rocks on which *Ulothrix*, in the vegetative stage, was collected in the early months of spring, when the water was 4.0 C°. The abundance of *Ulothrix* decreased gradually, disappearing almost entirely in the early summer. Collections in late spring also contained *Zygnema*, in the vegetative stages, intermingled with *Spirogyra*, *Tolypothrix*, *Oscillatoria* and *Rhizoclonium*.

From late summer to fall the region between these two bridges was covered by a mat of *Hydrodictyon*, *Spirogyra* and other filamentous algae.

3). On the east side of Causeway Bridge, the clear water ran slowly and contained *Stigeoclonium* attached to submerged aquatics growing near the shore in late spring. At the same time, about two miles south of the bridge and also on the east shore, *Vaucheria* was found in fruiting stages in the shallow, sandy bottom.

North and south of this bridge as far down as Blackstone Bridge on the east bank, the red alga *Batrachospermum* was found in scattered localities. This alga grew in clusters on small stones near the shore and produced fruiting bodies in June.

On the west shore, half a mile south of the bridge, the water near the shore and farther away from it contained abundant nets of *Hydrodictyon*. Collections from the surface water as well as below contained this alga, after the beginning of June.

4). The water north of the Blackstone Bridge and especially just beneath the bridge contained abundant specimens of species of *Polycystis*, *Coelosphaerium* and *Anabaenopsis*. A small dam south of the bridge retarded the water flow, and probably caused the great accumulation of these forms under it. The "water bloom" of this region was observed in the fall.

Generally speaking, the filamentous green algae such as *Spirogyra*, *Mougeotia* and *Oedogonium* were widespread and long-lasting in occurrence. Mostly the vegetative stages were observed and only few of these algae were in reproductive stages when collected.

Lyngbya, a filamentous blue-green alga, was collected from May to autumn in many regions but especially at the Lincoln Bridge, where great masses were found in the fall.

The many other algae, unicellular, colonial and multicellular which are recorded in other parts of this paper were of widespread occurrence, either in the plankton, attached to submerged objects, or free floating on the surface. The vegetative stages of these algae and occasionally the reproductive stages were observed in fresh collections.

ALPHABETICAL LIST OF SPECIES

Amphora ovalis Kützing
Anabaena limnetica G. M. Smith
A. variabilis Kützing
A. viguieri Denis & Frémy
Anabaenopsis elenkinii Miller
Ankistrodesmus convolutus Corda
A. falcatus (Corda) Ralfs
A. falcatus var. acicularis (A. Braun) G. S. West
Aphanocapsa grevillei (Hass.) Rabenhorst
Aphanochaete repens A. Braun
Aphanothece clathrata G. S. West
A. microscopica Nägeli

A. stagnina (Spreng.) A. Braun
Asterionella formosa Hassall
A. gracillima (Hantzsch) Heiberg
Batrachospermum vagum (Roth) C. A. Agardh
Bulbochaete repanda Wittrock
B. scrobiculata (Tiff.) Tiffany
Bumilleria sicula Borzi
Caloneis silicula (Ehrenb.) Cleve var. inflata (Grun.) Cleve
Calothrix stellaris Bornet & Flahault
Ceratium hirundinella (O.F.M.) Schrank
Characiopsis acuta (A. Braun) Borzi
Chlamydomonas angulosa Dill
C. mucicola Schmidle
C. polypyrenoideum Prescott
C. snowii Printz
C. sphagnicola Fritsch & Takeda
Chlorella ellipsoidea Gerneck
C. vulgaris Beijerinck
Chlorococcum humicola (Näg.) Rabenhorst
Chroococcus limneticus Lemmermann
Closterium acerosum (Schrank) Ehrenberg
C. calosporum Wittrock
C. dianae Ehrenberg
C. didymotocum Ralfs
C. ehrenbergii Meneghini
C. incurvum de Brébisson
C. lagoense Nordstedt
C. lanceolatum Kützing
C. leibleinii Kützing
C. lunula (Müller) Nitzsch
C. moniliferum (Bory) Ehrenberg
C. turgidum Ehrenberg
C. sigmoideum Lagerheim & Nordstedt
Coelastrum microporum Nägeli
Coelosphaerium dubium Grunow
C naegelianum Unger
Coleochaete orbicularis Pringsheim
C. scutata de Brébisson
C. soluta (de Bréb.) Pringsheim
Cosmarium biretum de Brébisson var. trigibberum Nordstedt
C. broomei Thwaites
C. botrytis Meneghini
C. dentiferum Corda
C. formosulum Hoffman
C. formosulum var. nathorstii (Boldt) W. & G. S. West
C. granatum de Brébisson
C. margaritatum Roy & Biss.
C. monomazum Lundell
C. nitidulum DeNotaris
C. orbiculatum Ralfs
C. panamense Prese
C. protractum (Näg.) DeBary
C. pseudoconnatum Nordstedt
C. punctulatum de Brébisson
C. quadrum Lundell
C. reinforme (Ralfs) Archer
Cosmocladium hitchcockii (Wolle) G. M. Smith
Crucigenia truncata G. M. Smith
Cyclotella bodanica Eulenstein
C. bodanica var. stellata Skvortzow
C. comta (Ehrenb.) Kützing
Cymbella aspera (Ehrenb.) Cleve
C. tumida (de Bréb.) Van Heurck
Desmidium swartzii C. A. Agardh
Diatoma hiemale (Lyngbye) Heiberg var. mesodon (Ehrenb.) Grunow
D. vulgare Bory
Dinobryon sertularia Ehrenberg
Dictyosphaerium pulchellum Wood
Draparnaldia glomerata (Vauch.) C. A. Agardh
D. judayi Prescott
Epithemia turgida (Ehrenb.) Kützing
Euastrum elegans (de Bréb.) Kützing
E. pulchellum de Brébisson
E. verrucosum (Ehrenb.) Ralfs
Euglena gracilis Klebs

E. spirogyra Ehrenberg
Fragilaria capucina Desmazieres
F. construens (Ehrenb.) Grunow
F. crotonensis Kitton
F. crotonensis var. prolongata Grunow
Gloeocystis ampla (Kütz.) Lagerheim
G. gigas (Kütz.) Lagerheim
G. major Gerneck ex Lemmermann
G. vesiculosa Nägeli
Golenkinia paucispina W. & G. S. West
Gomphoneis herculeana (Ehrenb.) Cleve var. robusta (Grun.) Cleve
Gomphonema acuminatum Ehrenberg
G. constrictum Ehrenberg
Gonatozygon kinahani (Arch.) Rabenhorst
Gymnodinium fuscum (Ehrenb.) Stein
G. palustre Schilling
Hormidiopsis ellipsoideum Prescott
Hyalotheca dissiliens (J. E. Smith) de Brébisson
Hydrodictyon reticulatum (L.) Lagerheim
Kirchneriella lunaris (Kirch.) Moebius var. irregularis G. M. Smith
Leptosira mediciana Borzi
Licmophora gracilis (Ehrenb.) Grunow
L. paradoxa (Lyngbye) C. A. Agardh
Lyngbya epiphytica Hieronymus
L. latissima Prescott
L. majuscula (Dill.) Harv.
L. wollei Farlow
Merismopedia punctata Meyen
Melosira italica (Ehrenb.) Kützing
M. juergensii C. A. Agardh
Micrasterias americana (Ehrenb.) Ralfs
M. apiculata (Ehrenb.) Meneghini
M. apiculata var. fimbriata (Ralfs) Nordstedt f. spinosa (Bissett) W. & G. S. West
M. radiata Hassall
M. rotata (Grev.) Ralfs
M. truncata (Corda) de Brébisson
Microspora willeana Lagerheim
Microthamnion kuetzingianum Nägeli
Mougeotia capucina (Bory) C. A. Agardh
M. floridana Transeau
M. genuflexa (Dillw.) C. A. Agardh
M. laetevirens (A. Braun) Wittrock
M. parvula Hassall
M. reinschii Transeau
M. robusta (de Bary) Wittrock
M. scalaris Hassall
Mougeotiopsis calospora Palla
Navicula anglica Ralfs
Netrium digitus (Ehrenb.) Itsigsohn & Roth
Nostoc muscorum C. A. Agardh
Oedogonium borisianum (Le Cl.) Wittrock
O. capillare (L.) Kützing
O. crenulatocostatum Wittrock
O. grande Kützing var. aequatoriale Wittrock
O. laeve Wittrock
O. plusiosporum Wittrock
O. pringsheimii Cramer
Oöcystis pusilla Hansgirg
Oscillatoria cortiana Meneghini
O. curviceps C. A. Agardh
O. ornata Kützing
O. prolifica (Grev.) Gomont
O. splendida Greville
O. tenuis C. A. Agardh
Pandorina morum (Muell.) Bory
Pediastrum biradiatum Meyen

P. boryanum (Turp.) Meneghini
P. boryanum var. longicorne Raciborski
P. duplex Meyen
P. duplex var. clathratum (A. Braun) Lagerheim
P. duplex var. rotundatum Lucks
P. duplex var. rugulosum Raciborski
P. ehrenbergii A. Braun
P. tetras (Ehrenb.) Ralfs
P. tetras var. tetraodon (Corda) Rabenhorst
Penium margaritaceum (Ehrenb.) de Brébisson
P. digitus (Ehrenb.) Itsigsohn & Roth
Peridinium cinctum (Müll.) Ehrenberg
Phacus longicauda (Ehrenb.) Dujardin
Phormidium nareanum Grunow
Pinnularia nobilis Ehrenberg
Planktosphaeria gelatinosa G. M. Smith
Pleurotaenium coronatum (de Bréb.) Rabenhorst
P. maximum (Reisch) Lund
P. trabecula (Ehrenb.) Nägeli
Polycystis aeruginosa Kützing
P. incerta Lemm.
Pleurococcus vulgaris Nägeli
Protoderma viride Kützing
Radiofilum flavescens G. S. West
Rhizochrysis limnetica G. M. Smith
Rhizoclonium hieroglyphicum (C. A. Ag.) Kützing
R. hieroglyphicum var. hosfordii (Wolle) Collins
R. hookeri Kützing
Scenedesmus abundans (Kirch.) Chodat
S. abundans var. brevicauda G. M. Smith
S. acutiformis Schroeder
S. arcuatus Lemmermann var. platydisca G. M. Smith
S. armatus (Chod.) G. M. Smith var. major G. M. Smith
S. bijuga (Turp.) Lagerheim
S. brasiliensis Bohlin
S. denticulatus Lagerheim
S. dimorphus (Turp.) Kützing
S. longus Meyen
S. longus var. minutus G. M. Smith
S. obliquus (Turp.) Kützing
S. quadricauda (Turp.) de Brébisson
S. quadricauda var. longispina (Chod.) G. M. Smith
Sorastrum americanum (Bohlin) Schmidle
Sphaeroceptis schroeteri Chodat
Spirogyra cleveana Transeau
S. ellipsospora Transeau
S. hydrodictya Transeau
S. jugalis (Fl. Dan) Kützing
S. mirabilis (Hass.) Kützing
S. nitida (Dillw.) Link
S. submaxima Transeau
Spirotaenia condensata Brébisson
Spirulina duplex Wolle
Spondylosium pulchellum Arch.
Staurastrum alternans de Brébisson
S. avicula de Brébisson
S. brevispinum de Brébisson var. tumidum G. M. Smith
S. cerastes Lund
S. crenulatum (Delp.) Nägeli
S. dickiei Ralfs var. maximum W. & G. S. West
S. dilatatum Ehrenberg
S. furcigerum de Brébisson
S. gracile Ralfs
S. grande Bulnheim
S. leptocladum var. denticulatum G. M. Smith
S. odontatum Wolle
S. orbiculare (Ehrenb.) Ralfs
S. paradoxum Meyen

S. subgrande Borge var. minus G. M. Smith
Stauroneis acuta W. Smith
Stigeoclonium flagelliferum Kützing
S. nanum Kützing
Surirella elegans Ehrenberg
S. splendida (Ehrenb.) Kützing
Synechocystis aquatilis Sauvageau
Synedra ulna (Nitzsch) Ehrenberg
S. ulna var. aequalis (Kütz.) Hustedt
Synura uvella Ehrenberg
Tabellaria fenestrata (Lyngb.) Kützing
T. flocculosa (Roth) Kützing
Tetraëdron limneticum Borge
Tetraspora cylindrica (Wahl.) C. A. Agardh
T. lubrica (Roth) C. A. Agardh
Tetrastrum staurogeniaeforme (Schroeder) Lemmermann
Tolypothrix conglutinata Borzi
T. distorta Kützing lanata Wartmann
Trachelomonas crebea (Kellicott) Deflandre
Tribonema bombycinum (C. A. Ag.) Derbés & Solier
Ulothrix tenerrima Kützing
U. zonata (Weber & Mohr) Kützing
Vaucheria ornithocephala C. A. Agardh
V. sessilis (Vauch.) DeCandolle
Westella linearis G. M. Smith
Xanthidium antilopaeum (de Bréb.) Kützing var. polymazum Nordstedt
Zygnema insigne (Hass.) Kützing

The following is an alphabetical list which shows the genera found by both Stone and the author, and those found only by Stone or by the author.

Stone and author	Stone	Author
Anabaena	Arthrodesmus	Anabaenopsis
Aphanochaete	Bambusina	Ankistrodesmus
Batrachospermum	Botrydium	Aphanocapsa
Bulbochaete	Calocylindrus	Aphanothece
Calothrix	Chaetophora	Bumbilleria
Closterium	Chara	Ceratium
Coelastrum	Characium	Characiopsis
Coelosphaerium	Chlamydococcus	Chlamydomonas
Coleochaete	Chroolepus	Chlorella
Cosmarium	Cladophora	Chlorococcum
Desmidium	Clathrocystis	Chroococcus
Dictyosphaerium	Conferva	Cosmocladium
Draparnaldia	Craterospermum	Crucigenia
Euastrum	Cylindrocapsa	Dinobryon
Euglena	Cylindrospermum	Golenkinia
Gloeocystis	Dimorphococcus	Gonatozygon
Hyalotheca	Docidium	Gymnodinium
Lyngbya	Eremosphaera	Hormidiopsis
Micrasterias	Gloeotrichia	Hydrodictyon
Microthamnion	Gonium	Kirchneriella

Nostoc
Oedogonium
Oscillatoria
Pandorina
Pediastrum
Penium
Pleurococcus
(Protococcus)
Rhizoclonium
Scenedesmus
Sorastrum
Spirogyra
Stigeoclonium
Staurastrum
Tetraspora
Tolypothrix
Ulothrix
Vaucheria
Xanthidium
Zygnema

Hapalosiphon
Hydrurus
Isactis
Leptothrix
Mesocarpus
Mesotaenium
Nephrocytium
Nitella
Ophiocytium
Palmella
Pleurocarpus
Polyedrium
Porphyridium
Raphidium
Rivularia
Schizochlamys
Scytonema
Sirosiphon
Sphaerozosma
Stauraspermum
Tetmemorus
Volvox

Leptosira
Merismopedia
Microspora
Mougeotia
Mougeotiopsis
Netrium
Oöcystis
Peridinium
Phacus
Phormidium
Planktosphaeria
Pleurotaenium
Protoderma
Polycystis
Radiofilum
Rhizochrysis
Sphaerocystis
Spirotaenia
Spirulina
Spondylosium
Synechocystis
Synura
Tetraëdron
Tetrastrum
Trachelomonas
Tribonema
Westella

Diatoms excluded from above lists.

DISCUSSION — It is possible that some of the differences in the algae collected by Stone and the author may be due to the fact that Stone listed algal names now regarded as synonymous. This may be one explanation as to the great difference in the number of species listed by the author. However, the difference in the number of Desmid species, especially, cannot be due solely to differences in nomenclature. The reason why the number of species, especially Desmids, decreased between 1900-1960 could be because the environmental conditions in Lake Quinsigamond have changed.

The chief environmental factors are light, temperature, chemical composition and pH of water. The first two factors were not recorded in Stone's paper. Therefore, there is no way to compare and discover what changes have occurred

in these two factors from 1900 to 1960. However, there is at least one external environmental factor which has been introduced on the lake during this 60-year period, and that is the presence of motor boats. Outboard motor boats deposit a film of oil on the surface of the lake. This oil is then moved, by the motion of waves, to the shores or coves. These coves are the best habitats for the planktonic Desmids. If the water is covered with an oily film, atmospheric oxygen cannot dissolve into the water and as a result the respiration of Desmids will eventually cease. This unfavorable environment probably inhibited growth of certain Desmids.

Five species of *Chara* and six species of *Nitella* were found by Stone. The author was not successful in collecting any species of these genera. One possible reason is that "*Chara* thrive best in clear, hard water (Smith 1950)." The Health Department of Worcester stated that in 1945 the water in Lake Quinsigamond was quite soft, the hardness being 23. It may be that the water today exhibits an even lower degree of hardness due to factory pollutions (personal communication, Health Department, Worcester, Mass.). However, this fact has not been substantiated either by the Worcester Health Department or by the author. Another possible reason is that there are many ducks on the lake and they feed upon these algae.

The range of pH values of water samples in Lake Quinsigamond was 6.5-7.8. However, there was one exception, namely, the water sample taken from the west shore, one half mile south of Causeway Bridge. This water in which tremendous quantities of *Hydrodictyon* were found has a pH of 9.0 in June. It is interesting to note that this finding supports the following statement: "*Hydrodictyon* may be used as an index organism for a high pH (Prescott, 1951)."

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NOMENCLATURAL NOTES ON TWO SOUTHEASTERN RHYNCHOSIAS

ROBERT L. WILBUR[1]

In 1834 Nuttall described what he considered to be a new genus of legumes from Florida naming its only species *Pitcheria galactoides*. Almost all authors since, including Bentham (Gen. Pl. 1: 543. 1865) and Taubert (in Engler and Prantl's Nat. Pfl. III. 3: 373. 1894), have treated it as a species of *Rhynchosia*. Burkart (Darwiniana **11**: 268, 269. 1957) also concluded that it did not merit generic rank and that it had close affinities with species in the Antilles and South America. He noted that the name most commonly employed under *Rhynchosia* was illegitimate, being a later homonym of *R. galactioides* (H.B.K.) DC. This later homonym is, of course, illegitimate even though the prior species with the earlier name has long been considered a member of the genus *Calopogonium*. Burkart therefore provided a new name, *R. pitcheria*.

However, Bertoloni in an often overlooked paper named this species *Lespedeza cytisoides* more than one hundred years earlier. In spite of Bertoloni's unfortunate decision as to the generic placement of this as well as many other species described by him from the Southeast, there can be no doubt as to the identity of the species as it was fully described and accompanied by a full-page plate. Asa Gray in his review (Am. Jour. Sci. II. **14**: 114-115. 1852) of Bertoloni's contribution unhesitatingly assigned the name to the synonymy of *Pitcheria galactoides*. Therefore the following new combination is required for this Gulf Coast endemic:

Rhynchosia cytisoides (Bert.) comb. nov.

Pitcheria galactoides Nutt., Jour. Acad. Phil. I. **7**: 94. 1834.

Rhynchosia galactioides (Nutt.) Endl. ex Walp., Repert. Bot. System. **1**: 790. 1842 but not *R. galactioides* (H.B.K.) DC., Prodr. **2**: 387. 1825.

Lespedeza cytisoides Bert., Mem. Acad. Sci. Bologna **2**: 278. 1850.

Rhynchosia pitcheria Burkart, Darwiniana **11**: 268. 1957.

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The binomials most recently employed for the erect, unifoliolate *Rhynchosia* of the southeastern Coastal Plain have been either *R. simplicifolia* (Walt.) Wood or *R. reniformis* (Pursh) DC. Since neither of these names is fully in accord with the current International Code, a brief discussion seems desirable.

The most widely used name, *R. simplicifolia* (Walt.) Wood, is a later homonym of *R. simplicifolia* (H.B.K.) DC., and hence is not legitimate (Art. 64.2).

Recently Turner (The Legumes of Texas, p. 255. 1959) has taken up *R. reniformis* (Pursh) DC. for this species. However Pursh published this as *Glycine reniformis* with *Trifolium simplicifolium* Walt. listed in synonymy. There was no presently acceptable reason why Pursh should not then have taken up Walter's epithet as *Glycine simplicifolia* H.B.K. was not published until 1823 or nine years after Pursh's publication. Hence *G. reniformis* Pursh is an illegitimate name as it was superfluous when published (Art. 64.1).

The desirability of Article 64.1 has been recently challenged by both Furtado (Taxon **9**: 147-150. 1960) and Holttum (Taxon **10**: 33-34. 1961). Furtado's long campaign against this portion of the Code has now entered its third decade having been rejected most recently by the Montreal Botanical Congress. Holttum argues that "a number of well-known and long used names, which under Art. 64.1 have been regarded as unusable, could be used" if this portion of the Code were eliminated and botanists relied instead upon typification and priority to rule unaided. This is no doubt true but it is certain also that the elimination of this provision would change the names of a very large number of plants to which botanists have become accustomed in the more than thirty years that the present provision has been in effect. As Fosberg points out (Taxon 8: 65. 1959) Art. 64.1 is indeed "a two-edged sword." Without wishing to debate the original merits of our Art. 64.1, I believe it now would serve stability better to retain the primary strictures of this provision.

Fortunately however, for the sake of at least some stabili-

ty, Article 72 permits the retention of one of the binomials by which this unifoliolate *Rhynchosia* has been known in the past. There was no epithet available in 1825 that could have been transferred by DeCandolle into *Rhynchosia* but the binomial *R. reniformis* then published by him need be no more considered as a new combination than are *Desmodium rotundifolium* or *D. lineatum*. All three of these names were first published by DeCandolle who cited as synonyms names which were later homonyms. All are or should be credited solely to DeCandolle with no parenthetical authority. The synonymy of the species is listed below.

Rhynchosia reniformis DC.

Trifolium simplicifolium Walt., Fl. Car. 184. 1788.

Glycine tomentosa var. *ϕ monophylla* Michx., Fl. Bor. Am. **2:** 63. 1803.

Glycine reniformis Pursh, Fl. Am. Sept. 486. 1814. *nom. illegit.* (Art. 64.1)

Arcyphyllum simplicifolium (Walt.) Ell., Jour. Acad. Phil. I. **1:** 371. 1818.

Glycine monophylla (Michx.) Nutt., Gen. N. Am. Pl. **2:** 115. 1818, not Linnaeus, Mant. **1:** 101. 1767.

Glycine simplicifolia (Walt.) Ell., Sk. Bot. S. C. & Ga. **2:** 234. 1823, not *G. simplicifolia* H.B.K., Nov. Gen. et Sp. **6:** 419. 1823.

Rhynchosia reniformis DC., Prodr. **2:** 384. 1825.

Rhynchosia tomentosa var *monophylla* (Michx.) T. & G., Fl. N. Am. **1:** 284. 1838.

Phaseolus reniformis (Pursh) Eaton & Wright, N. Am. Bot. 353. 1840.

Psoralea alnifolia Bert., Mem. Acad. Sci. Bologna **2:** 274. 1850.

Rhynchosia simplicifolia (Walt.) Wood, Class-Book 321. 1861, not DC., Prodr. **2:** 389. 1825.

Dolicholus simplicifolius (Walt.) Vail, Bull. Torrey Club **26:** 114. 1899. — DEPARTMENT OF BOTANY, DUKE UNIVERSITY.

THE OCCURRENCE AND HYBRID NATURE OF AN ENCHANTER'S NIGHTSHADE IN OHIO

TOM S. COOPERRIDER

Floristic work by the writer[1] and one of his students in northeastern Ohio during the summer of 1960 yielded two collections of *Circaea canadensis* Hill, making it possible to add this species with certainty to the known state flora. Schaffner (1932) noted that this species had been reported for the state but that he had seen no specimens. The state is not cited as part of the species range in either of the two regional manuals (Fernald, 1950; Gleason, 1952), but its known occurrences in neighboring states of Pennsylvania, West Virginia, and Michigan make its presence here not unexpected. Examination of the *Circaea* specimens in the Herbarium of The Ohio State University[2] disclosed one earlier collection: *Ash Cave, Hocking County, E. A. Albaugh & Len. Stephenson, Summer, 1930.* This is a fragmentary specimen originally identified as *C. lutetiana* L., but is undoubtedly *C. canadensis.* This station, located in southeastern Ohio, has not yet been visited by the writer.

The two newly discovered stations are in the extreme northeastern part of the state. The original collections from both have been added to the Herbarium of Kent State University. The collection data are:

(1) Open wooded slope; east side of Brewster Road and north of Chagrin River where the two cross; Bainbridge Township, Geauga County. *W. D. Hawver 1123*, July 25, 1960. (2) Moist, rocky, wooded valley of Mill Creek at "Cassey's Springs" area, 2 miles NNW of Mesopotamia, Mesopotamia Twp., Trumbull County. *Tom S. Cooperrider 7924*, Aug. 11, 1960.

The nature of *C. canadensis* has been the subject of past conjecture, Gleason *(op. cit.)* noting that it is often considered a hybrid between the other two species *Circaea* in this area: *C. alpina* L. and *C. quadrisulcata* (Maxim.) Franch.

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[1]This field work was supported by a Kent State University Summer Faculty Research Appointment.

[2]Appreciation is expressed to Dr. Clara Weishaupt, curator of the herbarium, for the loan of these specimens.

& Sav. Fernald (1917), however, decided that the "range of the three species does not coincide and there is little to suggest hybrid characters". Field examination of the two newly discovered Ohio stations for *C. canadensis*, and measurements in the herbarium on a sample of ten or more specimens of this taxon from each location suggest that a re-evaluation of Fernald's arguments is appropriate.

Both stations in northeastern Ohio were studied in the summer of 1961. They are remarkably similar. Each is centered in a deep ravine of the type known locally as a "hemlock gorge". In each ravine, all three taxa of *Circaea* are growing. At the head of both ravines, a small stream falls over a sandstone cliff about 20 feet in height. *C. alpina* grows on or near the cliff in a moist, north-facing situation, usually on dripping, mossy ledges. Colonies of *C. canadensis* are in the rocky, wooded valley a few hundred feet downstream from the cliffs. In both valleys, some plants of *C. quadrisulcata* grow within a few feet of the *C. canadensis* plants. *C. quadrisulcata* is more abundant, however, in the dry, upland woods bordering the ravines. The proximity of the three taxa at these two stations would negate any argument against hybridization based on spatial separation.

That *C. canadensis* is generally intermediate in morphology between the other two species is apparent from casual observation (Plate 1267, Fig. 1) More specifically, its intermediacy with regard to:

stature,
length of leaf,
length of leading raceme,
width of calyx lobe,
length of corolla lobe,
length of anther,
length of fruit pedicel, and
thickness of fruit

has been noted previously (Fernald, 1950; Gleason, 1952). Cursory measurements on Ohio specimens indicate that it is also intermediate, both in range of variation and in mean, with respect to:

number of internodes above roots,
position of longest internode,
length of longest internode,
width of leaf blade,
length of flower bud,
length of disk above hypanthium,
length of calyx lobe,
w dth of corolla lobe,
length of filament, and
size of pollen grain.

Stebbins (1950, p. 26) has reasoned on a genetic basis that "the larger the number of characters in which a particular plant can be found to be intermediate betweeen its putative parents, the greater is the probability of its hybrid origin". The large number of morphologically intermediate charac-

PLATE 1267

FIG. 1. Habit of representative plants. Left, *Circaea quadrisulcata;* center, *C. canadensis;* right, *C. alpina* (all × 1/6). FIG. 2. Fruiting racemes collected from Geauga Co., Sept. 9, 1961. Left, *C. alpina;* center, *C. canadensis;* right, *C. quadrisulcata* (all × ¼). FIG. 3. *C. quadrisulcata*, six pollen grains that stained with aniline blue (× 100). FIG. 4. *C. canadensis*, three pollen grains that did not stain with aniline blue (× 100). FIG. 5. *C. alpina*, three pollen grains that stained with aniline blue, one that did not (× 100).

ters in this case supports the notion of hybrid origin of *C. canadensis*.

Failure of fruit to set on *C. canadensis* is relevant. This feature is noted by Gleason (*op. cit.*), but not by Fernald (1917, 1950). Careful searching of the plants of *C. canadensis* in northeastern Ohio disclosed none with even a single fruit set in early September, 1961. Nearby plants of the other two species had set fruit abundantly (Fig. 2). Plants of all three taxa moved into garden culture in Spring of 1961 showed a similar pattern, both *C. alpina* and *C. quadrisulcata* set fruit abundantly; plants of *C. canadensis*, observed until killed by frost, set no fruit.

Fresh pollen of plants from each of the two stations in northeastern Ohio was stained with aniline blue in lactophenol (Fig. 3-5), a technique described by Lawrence (1951, p. 71) and Long (1959) as a test for fertility and, hence, possible hybridity. Pollen taken from two to six plants of each taxon from these two stations gave the following results:

1. For *C. alpina*, of 747 grains counted, 592 (79%) stained dark blue and 155 (21%) took no blue stain.
2. For *C. quadrisulcata*, of 1000 grains counted, 791 (79%) stained dark blue and 209 (21%) took no blue stain.
3. For *C. canadensis*, of 2036 grains counted, 11 (0.5%) stained dark blue, 173 (8.5%) showed a dark blue spot on the body of the grain, and 1852 (91%) took no blue stain.

Assuming only those grains which stained completely to be "good", this count reveals that while the amount of good pollen produced by *C. alpina* and *C. quadrisulcata* is 79%, that of nearby plants of *C. canadensis* is less than 1%. A second generalization by Stebbins (1950, p. 27) on the nature of interspecific hybrids is pertinent. "If the plant is completely healthy and growing in company with its putative parents, then the discovery of a high-proportion of well-filled pollen grains in the latter and 50% or more of empty ones in the suspected plant is strong evidence that this plant is a hybrid between the two forms that are partly isolated from each other genetically."

On the basis of spatial proximity, morphological intermediacy, and sterility, as indicated by failure of fruit to set and production of only a small percentage of good pollen, it seems reasonable to conclude that these plants of *C. canadensis* in northeastern Ohio are indeed interspecific hybrids of *C. alpina* x *C. quadrisulcata.*

In connection with the planning of further study of the matter, it is noteworthy that a similar, or perhaps the same, situation exists in Europe in *C. intermedia* Ehrh., which Fernald (1917) considered conspecific with *C. canadensis.* *C. intermedia* has been variously considered as a *Form* of *C. alpina,* a *Form* of *C. lutetiana,* an interspecific hybrid between the two, and as a distinct species (Hegi, 1908; Gagnepain, 1916). — DEPARTMENT OF BIOLOGICAL SCIENCES, KENT STATE UNIVERSITY, KENT, OHIO.

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THE TAXONOMY OF SETCREASEA OVATA

SHAMIM A. FARUQI, R. P. CELARIER[1] AND K. L. MEHRA

Setcreasea ovata is a variable taxon which has frequently been confused with *S. brevifolia* (Torr.) Sch. et Sydow. Johnston (1944) in an attempt to clarify the differences between *S. brevifolia* and *S. buckleyi* Jtn. mentioned specimens from the Chisos and Davis Mts. of Texas as *S. brevifolia*, but actually referred them to *S. ovata*. On the other hand, Rose (1899) included *S. ovata* as a synonym of *S. brevifolia*. This confusion is primarily due to the similarity of leaf shape of these two species. Also, morphological studies have shown that *S. ovata* is very similar to *S. pallida* Rose in its floral characters.

S. pallida differs from *S. brevifolia* in possessing oblong-elliptic leaves, broad membranous connectives and glabrous ovaries, whereas *S. brevifolia* possesses elliptic-ovate leaves, narrow and thick connectives and pubescent ovaries. For a clear-cut differentiation of the two species, the following descriptive material should be helpful.

S. pallida: stem more or less 40 cm. tall; leaves oblong-elliptic; sepals 3; petals 3; stamens 6, epipetalous, connectives broad and membranous; ovary glabrous.

S. brevifolia: stem more or less 40 cm. tall; leaves ovate-elliptic; sepals 3; petals 3; stamens 6, epipetalous, connectives narrow and thick; ovary pubescent.

S. ovata was originally described by Coulter (1890) as *Tradescantia leiandra* var. *ovata*. *S. brevifolia* was also described as a variety of *T. leiandra* by Torrey (1859). Rose (1899) gave generic rank to this group of plants, characterized by having connate corollas and epipetalous stamens, under a new genus *Treleasea*. *Treleasea* being the name of an already described fungus, Schumann and Sydow (1899), changed it to *Setcreasea*. The rank of various species described by Rose in the treatment of Schumann and Sydow remained the same, and, as mentioned before, Rose had included var. *ovata* as a synonym under *S. brevifolia*.

The original description of Torrey (1859) for var. *brevi-*

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[1]Deceased December 23, 1959.

folia indicates a pubescent ovary. The colored plate included by Rose in his publication shows the same. These facts and others lead us to believe that both Rose and Johnston did not study the internal structures of *S. ovata* and presumed it to be *S. brevifolia* because of the close resemblance of the leaves in each case.

All of the taxa of *Setcreasea* that were studied experimentally in our laboratory show a vegetative mode of reproduction and a high degree of self-incompatibility. However, inter-specific hybridization is common. Even triploid hybrids are quite vigorous and are vegetatively normal. Therefore, the designation of specific rank to a new taxon should be made only with caution. However, the species *S. ovata* was found to be an exception to the generic tendency toward easy interspecific hybridization. We could not produce any hybrids involving either *S. brevifolia* or *S. pallida*. A single hybrid was produced by using *S. purpurea* as a female parent. The details of the crossing data are given in Table 1.

S. jaumavensis Matuda according to the type description is another species that comes very close to *S. ovata*.

TABLE I

Attempted Cross	Pollinations	Swollen ovary	Seed Set	Seedlings	Plant
S. ovata × *S. pallida*	17	1	2	none	none
S. ovata × *S. purpurea*	11	9	32	none	none
S. pallida × *S. ovata*	65	48	6	none	none
S. purpurea × *S. ovata*	22	11	29	1	1
S. brevifolia × *S. ovata*	12	6	11	none	none

2n=23

These species are similar in their floral structures. The type specimen of *S. jaumavensis* is a fragment of Rozhynsky's collection number 260, dated December 14, 1931, and is supposed to be in the herbarium of the New York Botanical Garden. This specimen has been misplaced, consequently it is at present unavailable. We came across another fragment of Rozhynsky's collection 260 from the herbarium of the Chicago Natural History Museum determined as *Tradescantia semisomna*. A very careful study of floral

parts showed a fused corolla and epipetalous stamens, the criteria used to separate the genus *Setcreasea* from *Tradescantia*. This plant is found to be similar to *S. ovata* both in floral and vegetative structures, consequently a doubt arose regarding the validity of *S. ovata* as a separate species. On the basis of the type description, the leaves of *S. jaumavensis* are broadly lanceolate and pubescent. In Rozhynsky 260 from the Chicago Natural History Museum the leaves are ovate and glabrous. The difference in leaf shape should not be too seriously considered due to the fact that in this specimen there are only two upper leaves present which may not represent a normal mature leaf. But the absence of leaf pubescence provides a very good reason to believe that Rozhynsky 260 from the Chicago Natural History Museum is not *S. jaumavensis*, rather it appears to be part of a mixed collection. Dr. Matuda (personal communication) is in agreement with the authors' opinion that *S. ovata* is distinctly different from *S. jaumavensis*, specially in leaf pubescence.

These studies point out that *S. ovata* is a distinct taxon which is not easily confused with any of the three species, i.e. *S. pallida, S. brevifolia* or *S. jaumavensis*. It certainly deserves specific rank.

S. ovata (Coulter) Faruqi, Celarier and Mehra, stat. nov.

Based on *Tradescantia leiandra* var. *ovata* Coulter, Contr. U. S. Nat. Herb. **1**: 50, 1890.

Plant perennial with underground rhizome; aerial stem usually erect, great variation in the height of the plant, 20-30 cm. or more; leaves elliptic or ovate; inflorescence terminal subtended by two leafy bracts; pedicel pubescent; calyx 3; corolla 3, pink; stamens 6, epipetalous, connectives broad membranous; ovary glabrous.

TYPE: Texas. *Neally 1889* (US).

TEXAS: Chisos Mts. Brewster Co. *Hinckley 7-31-1940* (GH); *Hinckley 1113* (F); *Havard 78* (GH, US); *Warnock T 574 C* (GH, US, F); *Warnock 643* (US); *Sperry 1476* (GH, US); *Moore & Steyermark 3228* (GH, MO, F); *Mueller 7854* (F, US, MO, MICH); *Young 122* (MO); *McDougall 33* (GH); Birdmine Hill, East of Alpine, *Warnock 21589* (MO, F); Railroad at Rio Grande, *Eggert 1737023* (MO); Devils River, *Clark 4138* (MO).

MEXICO: **Coahuila:** North of Cañon de Cienegas, *White 1899* (MICH); Villa Acuña, *Wynd and Mueller 624* (GH, MO); Muzquiz, *Wynd and Mueller 335,* (GH, US); Soledad, SW of Monclova, *Palmer 2014* (GH);

Sierra de la Encantada, Rancho Buena Vista, *Stewart 1438* (GH); Sierra del Pino, Head of Cañon Ybarra, *Stewart 1257* (GH); Sierra de las Cruces, *Stewart 1109* (GH); Cuatro Cienegas, *Marsh 2049* (GH). **Nuevo León:** Sabinas Hidalgo, *Leavenworth* 43 (F).

Morphologically this species is very closely related to *S. pallida*. The production of a hybrid with *S. purpurea* also points out a relationship. The indecisiveness of negative results from crossing as stated by Rollins (1953) for genera is valuable as well for the species relationship. The production of a hybrid indicates its relationship with *S. purpurea* while it does not negate a potential relationship to *S. pallida*. We may point out that there also exists a close relationship between *S. pallida* and *S. purpurea*. Both *S. ovata* and *S. purpurea* used as parents are tetraploids with $2n = 24$ chromosomes, while *S. pallida* is a diploid. From the crosses involving this tetraploid, *S. purpurea*, and *S. pallida* it is also concluded (unpublished) that *S. pallida* has contributed one genome to the tetraploid *S. purpurea*. *S. purpurea* has also been reported in diploid condition (Bose, 1959). The relationships between these three morphologically closely related species cannot be fully understood without more experimental evidence especially involving diploid *S. purpurea*. Superficially *S. ovata* looks very much

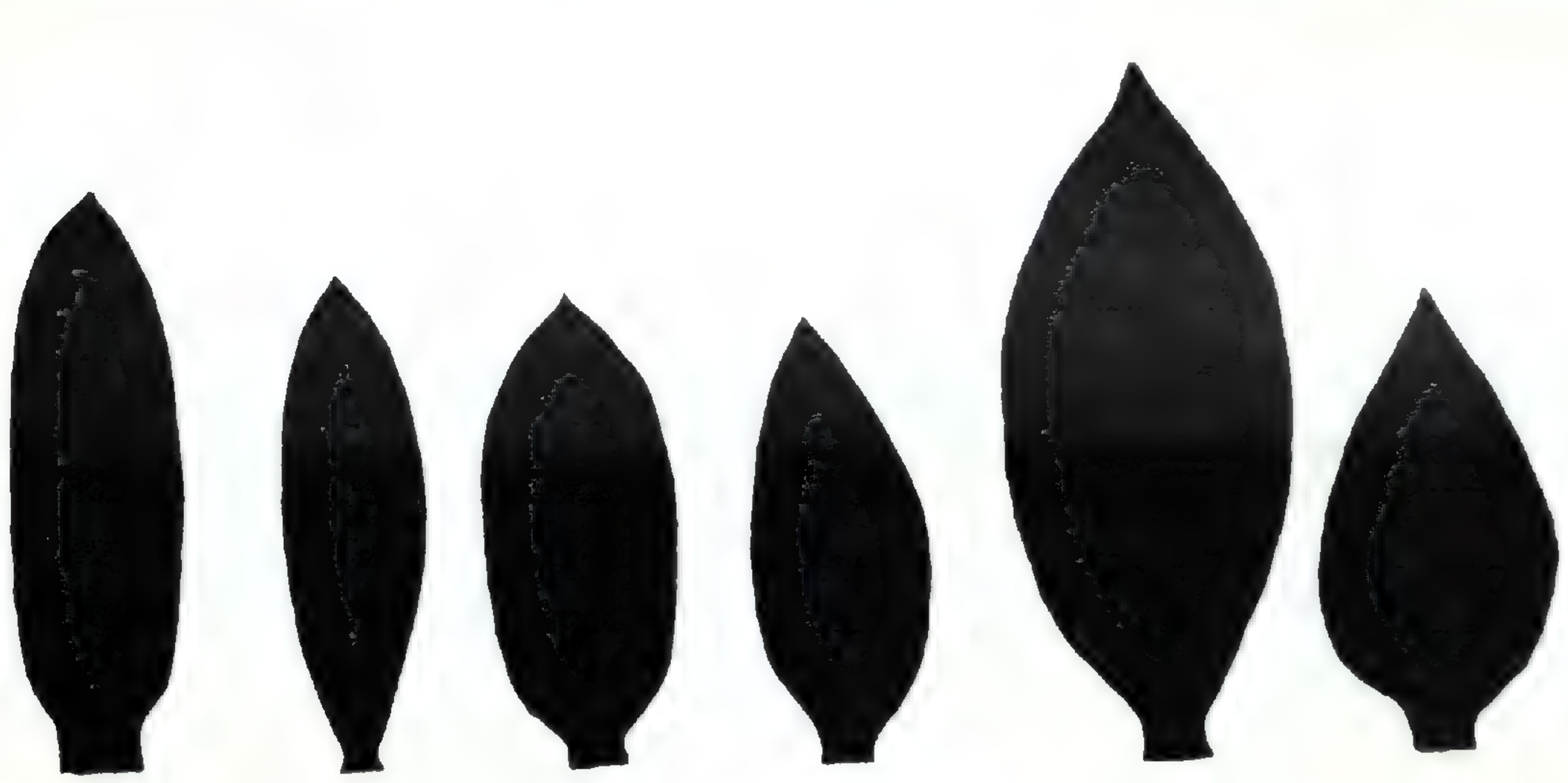

FIG. 1. Leaf shape in *S. pallida;* FIG. 2-4. Leaf shape variation in *S. ovata;* FIG. 5-6. *S. brevifolia*. Figures represent half of the actual leaf size.

like a segmental allotetraploid between two ecotypes of *S. pallida*.

S. ovata was once described as a variety of *S. leiandra* but morphological data do not provide any basis for a direct relationship between the two species. Our studies indicate that *S. leiandra* is a somewhat specialized species directly related to one of the more primitive species, *S. australis*. The line of evolution here is apparently different from that of *S. purpurea*, *S. pallida* and *S. brevifolia*. *S. ovata* and *S. brevifolia* were included as varieties of *S. leiandra* at the time when the genus *Setcreasea* did not exist. The early reference indicates a broad group relationship rather than a direct close one.

The most characteristic feature of *S. ovata* is the presence of a very strong underground rhizome. This provides a very efficient method of vegetative reproduction. The other experimentally known species of this genus also possess a vegetative mode of reproduction. These species, as pointed out earlier, are easily crossed, but they lack an underground rhizome. In the latter, only aerial branches in contact with soil for a period of time are able to produce roots. This method is by no means efficient enough to colonize an area.

Whether strong vegetative reproduction is a direct outcome of polyploidy or if it has evolved through selection cannot be answered without further experimentation and field study. Absence of a rhizome in herbarium specimens may not necessarily mean its absence in nature. It may be due to incomplete collection. It may only be said that a capacity for vegetative propagation is present in the near relatives, a condition preliminary to efficient vegetative reproduction, as pointed out by Darlington (1956).

Within *S. ovata* a range of variation in leaf shape is found from narrowly elliptic to ovate. Superficially it looks like a range of variation that would be expected of intermediates between *S. pallida* and *S. brevifolia* (fig. 1-6). From the available data it does not seem to be the result of introgression involving these two species. First of all, no tetraploid *S. pallida* has been reported, and *S. ovata* is not a triploid. On the basis of experimental evidence from crossing data

a free exchange of genes with *S. brevifolia* does not seem to be probable. One way this variation could be explained is through mutations as found in *Cyrilla* (Thomas, 1960).

ACKNOWLEDGEMENTS

Thanks are extended to the curators of the Gray Herbarium of Harvard University, Cambridge; United States National Herbarium, Washington, D. C.; Missouri Botanical Garden, St. Louis; Chicago Natural History Museum, Chicago, and Herbarium of the University of Michigan, Ann Arbor for the loan of the herbarium specimens. The authors are also indebted to Mr. Robert M. Ahring, in charge of U.S.D.A. Seed Testing Laboratory, Stillwater, for the germination tests on hybrid seeds. A critical review by Professor Reed C. Rollins, Director, Gray Herbarium, Harvard University, Cambridge, Mass., and helpful suggestions of Professor Jack R. Harlan, Department of Agronomy, and Dr. J. M. J. de Wet Department of Botany, Oklahoma State University, Stillwater, Oklahoma are highly appreciated. — DEPARTMENT OF BOTANY AND PLANT PATHOLOGY, OKLAHOMA STATE UNIVERSITY, STILLWATER, OKLAHOMA.

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THE VARIETIES OF LUZULA ACUMINATA[1]

JOHN E. EBINGER

The woodrush, *Luzula acuminata*, is confined to the eastern United States and Canada where it is of rather sporadic occurrence. This early-blooming species is usually restricted to moist open woodlands but is occasionally found along roadsides and in other open areas. It was not until the work of Rafinesque (1840) that the specific distinctions between this North American species and the European species *L. pilosa* were noticed. Even here Rafinesque mentions that this North American species, *L. acuminata*, is perhaps *L. pilosa*. Before this time the American species was combined with *L. pilosa*, although Schultes and Schultes (1829) and Hooker (1840) considered it a variety of *L. pilosa*.

Watson (1879) also considered that the North American species was specifically distinct and, apparently unaware of Rafinesque's earlier name, proposed for it the name *Luzula carolinae*. Later, Fernald (1903), also apparently unaware of the earlier name by Rafinesque, proposed the name *L. saltuensis* for the North American species. In contrast, he considered *L. carolinae* to represent a local species of the Carolina mountains, similar to the Asiatic species *L. plumosa*.

There has been a difference of opinion concerning the treatment of the *Luzula acuminata* complex. Some authors have treated this complex as being one species, others as two species and others as varieties of one species. In most instances the two entities are recognized as varieties and both Fernald (1950) and Gleason (1952), in the two major floras of the northeastern United States, treat the species in this manner. In both cases the two varieties are separated on the basis of the number of secondary pedicels in the inflorescence though Fernald (1950), also mentions that the color of the perianth may differ.

[1]The author would like to thank Dr. John R. Reeder for his helpful criticisms during the progress of this study and the preparation of the paper. I am also grateful to the curators of the Gray Herbarium (GH) and of the United States National Herbarium (US) for the loan of herbarium material.

Jones (1950) used the binomial *Luzula saltuensis* in his flora of Illinois since he does not agree with Fernald regarding the name *L. acuminata*. Jones (1951) suggests that this name should be rejected as a *nomen dubium* because, in his opinion, Rafinesque's description is ambiguous. He objects to the fact that Rafinesque described the North American plant as having glabrous leaves that are less than three inches long; an inflorescence which is congested and not exceeding the leaves; and flowers that are small.

When considering fruiting material the objections of Jones are well founded; however, with respect to flowering material Rafinesque's description is correct. The leaves in young material, particularly the cauline ones, are less than three inches long and quite glabrous except for the silky marginal hairs that are usually present in all *Luzula* species. Also, some specimens of this species have been found that are completely glabrous. In young flowering material the inflorescence is congested and does not exceed the leaves and the flowers are small. In my opinion the description by Rafinesque is not correct when fruiting material is considered, but is when young flowering material is used. Furthermore, the fact that Rafinesque states that the inflorescence is corymbose and that the plant is closely related to *L. pilosa*, excludes any other Eastern North American species of *Luzula*.

Though Rafinesque's description leaves no doubt as to which species he was referring, it is impossible to determine with certainty which of the two entities (*acuminata* or *carolinae*) he was describing. However, the fact that he mentions that the type locality is boreal America indicates he was referring to the northern variety (var. *acuminata*). Furthermore, this same interpretation was made by Fernald (1944) when he considered the northern entity to be variety *acuminata* and reduced *Luzula carolinae* S. Wats. to a variety of *L. acuminata*. Along with this confusion concerning the correct name there is some lack of agreement as to whether one or two species are involved. In this paper it will be shown that there is only one species in this complex, but that there are two varieties that can be separated

and that each has a distinct geographic distribution.

MATERIALS AND METHODS

The basis of this study was herbarium material, and more than 200 collections from Northeastern United States and Canada were studied. The herbarium specimens were examined for the characters mentioned below and a diligent search was also made for any additional morphological criteria which might be of significance. For determination of anther and filament lengths flowering material was used since after the pollen is discharged there is a slight decrease in anther size. For all other measurements and observations mature fruiting specimens were studied. Finally, the results obtained were plotted on a map to show the geographic distribution of the two varieties.

All material used in this study was obtained from the U.S. National Herbarium (US), the Gray Herbarium (GH), and the Yale University herbarium (YU).

DISCUSSION

To separate the two varieties of *Luzula acuminata*, Fernald (1938) used the relative lengths of the filaments and anthers, the length of the bracts at the base of the inflorescence, the color of the perianth segments, and the forking rays of the inflorescence. The present study has revealed that most of these characters are completely unreliable: in fact, the only usable trait is the forking rays of the inflorescence (secondary pedicels that develop just beneath the flowers to form a compound corymb).

The anther and filament of every flowering specimen was measured and it was found that there is no appreciable difference in the two series. In variety *carolinae* the average filament length is 0.5 mm and the anther length is 1.2 mm, while in variety *acuminata* the average length is 0.4 mm for the filament and 1.4 mm for the anther. Not only are the lengths very similar, but the variation overlaps so that it is impossible to distinguish between the two series by using this character.

Measurements were also made of the bract at the base of the inflorescence. In both varieties the length is nearly the same and it is always shorter than the fruiting inflores-

cence. Fernald (1938) mentions that the type of variety *carolinae* has the inflorescence overtopped by an erect frondose bract. Upon careful examination of this type specimen (Gray and Carey, July 1841), it was found that the frondose bract, mentioned by Fernald, is actually the upper cauline leaf. Above this leaf is a small bract that does not overtop the inflorescence.

Fernald (1938) also mentions that castaneous perianth segments are common in variety *carolinae*. A number of specimens of this variety do have castaneous sepals and petals, but this character is also found in some specimens of variety *acuminata* and therefore cannot be used to separate the two entities. Also, some specimens of variety *carolinae* have stramineous to light brown perianth segments, a characteristic which is common in variety *acuminata*.

The only reliable character found to separate the two varieties is the number of forking rays, i.e. secondary pedicels, in the inflorescence. In variety *acuminata* the number of primary pedicels in the corymbose inflorescence varies from 7 to 16 with an average of 10 or 11. Secondary pedicels are usually lacking in this variety, but occasionally one or two are found. When secondary pedicels occur they are restricted to one or two of the primary pedicels. Also, they are usually restricted to one inflorescence of the specimen while the other inflorescences lack secondary pedicels. In variety *carolinae*, in contrast, the inflorescence is always a compound corymb with the number of primary pedicels varying from 9 to 18 and with an average of 12 or 13. In all the inflorescences of a specimen of this variety, many of the primary pedicels have at least one secondary pedicel growing from them. Sometimes 2, 3 or 4 secondary pedicels are found on one or more of the primary pedicels. The average number of secondary pedicels found in an inflorescence of this variety is 8 or 9 but some inflorescence have as many as 20. Since variety *acuminata* sometimes has a few secondary pedicels in the inflorescence the ratio of the number of secondary pedicels to the number of primary pedicels was used as a means of separating the two varieties.

In scoring this character the primary and secondary pedicels in all of the inflorescences of each specimen were counted. From this count the ratio of the number of secondary to primary pedicels was found and the results were then plotted on a map (Fig. 1) to determine if the two

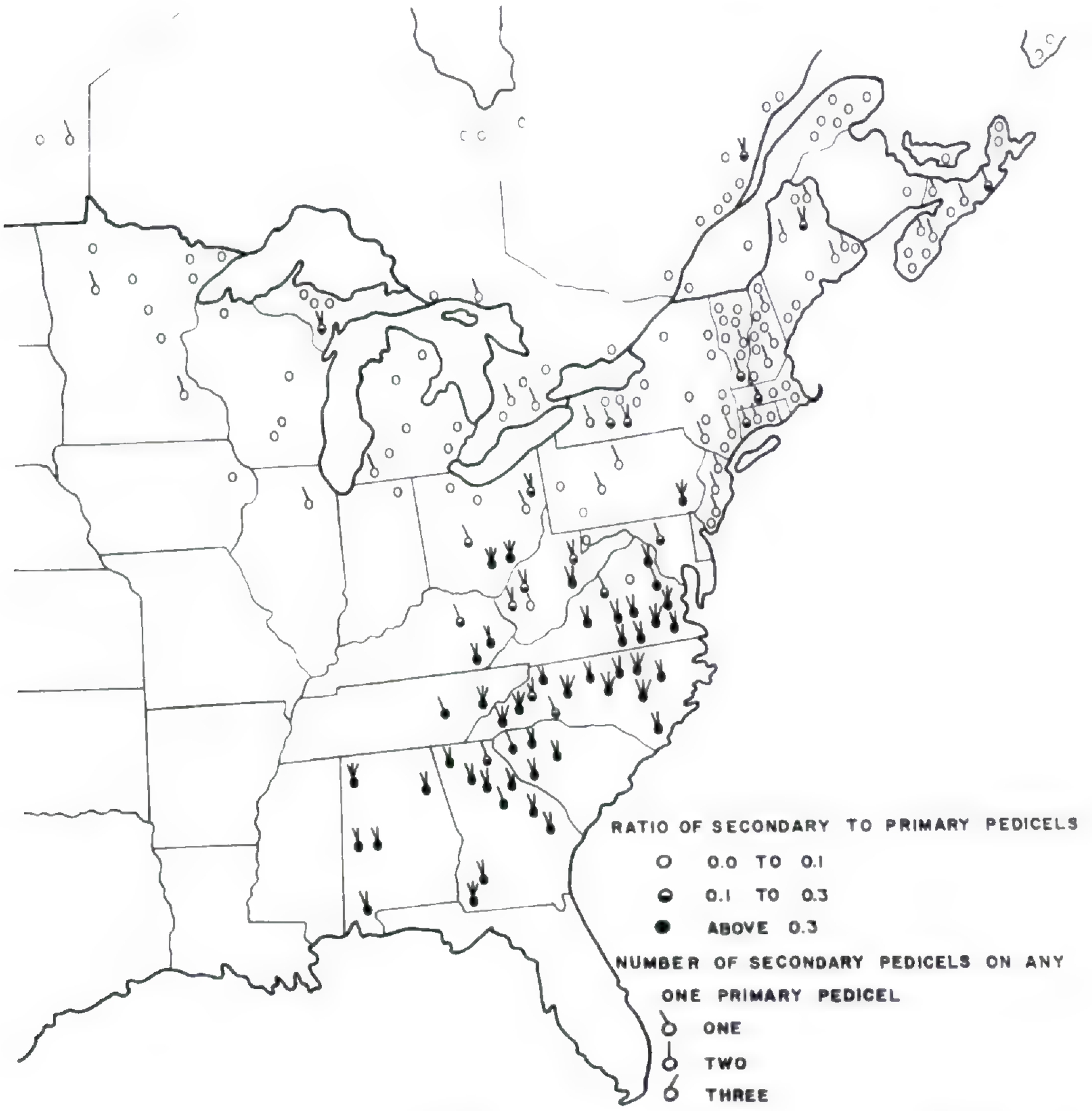

Fig. 1. Map showing the distribution of *Luzula acuminata* var. *acuminata* and *Luzula acuminata* var. *carolinae*. The open circles indicate specimens of variety *acuminata*, the darkened circles indicate specimens of variety *carolinae* and the half darkened circles indicate specimens that are intermediate between the two varieties with respect to the ratio of the number of secondary pedicels to primary pedicels. The bars radiating from the circles indicate the number of secondary pedicels that are present on any one of the primary pedicels of the inflorescence.

series have different geographic distributions. On this map an open circle indicates that the ratio is between 0 and 0.1 while a half darkened circle indicates a ratio between 0.1

and 0.3 and a completely darkened circle indicates that the ratio is greater than 0.3.

The number of secondary pedicels on any one primary pedicel is also indicated on the map. This character is shown by the bars radiating from the circle. A bar radiating from the left of the circle indicates that at least one primary pedicel in the inflorescence has one secondary pedicel growing from it, while a bar radiating from the top of the circle indicates that at least one primary pedicel has two secondary pedicels growing from it, and a line radiating from the right indicates that three secondary pedicels are present on at least one primary pedicel.

As can be seen from the map, variety *carolinae* has a southern distribution which extends from Alabama and Georgia, west to the Mississippi River, and north to southern Ohio and Pennsylvania. In contrast, variety *acuminata* has a more northern distribution. The southern boundary of this variety is southern Ohio and Pennsylvania, and in the west it extends to South Dakota and Manitoba, Canada. It is also common in southeastern Canada and the New England States.

In general, the region of high variability between the two varieties includes the states of Ohio, Pennsylvania, southern New York, West Virginia, Maryland and New Jersey. In this region of high variability there are numerous intermediate plants as well as some plants that are typical of both varieties. Excluding this region of high variability the two varieties are fairly constant in their characters. Variety *carolinae*, which is represented by the darkened circles with several bars radiating from them, is the southern variety. Of the 50 specimens studied from this area all but six have a ratio greater than 0.3. Of these six specimens, five have a ratio between 0.1 and 0.3 and the remaining specimen has a ratio of 0.0 and should be referred to variety *acuminata*. Also, most of the southern specimens have 2, 3 or more secondary pedicels growing from at least one primary pedicel in an inflorescence.

The northern variety (*acuminata*) is not as constant in its characters, but there can be no doubt in distinguishing

the two series. Of the 125 specimens studied from this region, 92 lack secondary pedicels. In the remaining 33 specimens, only eight have a ratio of secondary pedicels to primary pedicels between 0.1 and 0.3 while the remainder have a ratio of less than 0.1. No specimens were found with a ratio greater than 0.3. Also, of the 33 specimens that have secondary pedicels, only five have more than one secondary pedicel growing from any of the primary pedicels of the inflorescence, and in most cases no more than one secondary pedicel was found in an inflorescence.

The secondary pedicels found in the southern variety do not seem to be a result of a longer growing season. Even in young flowering specimens the flowers on the secondary pedicels are as well developed as the flowers on the primary pedicels, and both produce seed at nearly the same time. This indicates that the existence of secondary pedicels is not a result of the environment but that it is a genetically controlled factor.

TAXONOMIC TREATMENT

Since the results of this paper show that there are two varieties in this complex, a short taxonomic treatment of the two will be undertaken. This should help to clarify the nomenclature of the varieties since in the past there has been confusion as to the correct name.

Luzula acuminata Raf. Autikon Bot. 193. 1840

var. **acuminata**

Luzula pilosa (L.) Willd. var. *β. Americana* Schultes & Schultes Syst. Veg. 7:262. 1829.

Luzula pilosa (L.) Willd. var. *β*. Hook. Fl. Bor.-Am. 2: 188. 1840.

Luzula saltuensis Fern. Rhodora 5:195. 1903.

Juncoides saltuense (Fern.) Heller, Muhlenbergia 6:12. 1910.

Juncoides pilosum (L.) Coville var. *michiganense* Farwell, Rep. Mich. Acad. Sci. 20:170. 1918.

Juncoides pilosum (L.) Coville var. *saltuense* (Fern.) Farwell, Rep. Mich. Acad. Sci. 20:170. 1918.

Luzula carolinae S. Wats. var. *saltuensis* (Fern.) Fern. Rhodora 40:404. 1938.

This is the northern variety and can be separated from the more southern variety by the lack of secondary pedicels in the inflorescence. In specimens where secondary pedicels exist the ratio is always less than 0.3 and rarely is there more than one secondary pedicel to any one primary pedicel.

Luzula acuminata Raf. var **carolinae** (S. Wats.)
Fern. Rhodora **46**:5. 1944

Luzula carolinae S. Wats. Proc. Am. Acad. **14**:302. 1879.
Juncodes carolinae (S. Wats.) O. Ktze. Rev. Gen. Pl. **2**:724. 1891.

This variety has a much more southern distribution than variety *acuminata*. It can be distinguished from the more northern entity by the larger number of secondary pedicels in the inflorescence. Usually some of the primary pedicels have two or more secondary pedicels growing from them.

CONCLUSIONS

The above results show conclusively that there is a distinct difference between the two varieties and that each has a definite geographic range. Variety *acuminata* has a more northern distribution than variety *carolinae* and can easily be separated from the latter by its lack of secondary pedicels in the inflorescence. In the specimens of variety *acuminata* that do have secondary pedicels the ratio of these to the primary pedicels is always less than 0.3 and in most cases there is no more than one secondary pedicel to any of the primary pedicels. Just the opposite condition exists in the southern variety (*carolinae*). Here a ratio above 0.3 is always found and the ratio is sometimes greater than 1.0. Also most specimens of this southern variety have two or more secondary pedicels on some of the primary pedicels of the inflorescence.

In the region of high variability between the two series are a number of specimens that are difficult to place taxonomically. The large amount of variability in this region as well as the specimens of the northern variety that have secondary pedicels show that the two series intergrade into each other. This variability indicates that only two varieties are involved and that they are not separate species.

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REPRESENTATIVE SPECIMENS: **Luzula acuminata** Raf. var. **acuminata** UNITED STATES: South Dakota; *E. J. Palmer 37562* (GH). Minnesota: *Butters & Abbe 10* (GH); *J. W. Moore 21601* (US); *J. B. Moyle 387* (US); *Pease & Bean 26387* (GH); *Rosendahl 4966* (GH); *Rosendahl & Butters 4614* (GH). Iowa: *Thorne 10005* (US). Wisconsin: *Colby 4472* (US); *Fassett 2751* (GH) *2744* (GH). Michigan: *Farwell 2559* (GH), *4817* (GH), *4864* (GH), *5421* (GH). New York: *A. J. Eames 290* (GH); *Haberer 962* (GH); *House 8817* (GH), *9346* (GH), *21354* (GH), *22402* (GH); *McVaugh 4066* (GH); *Muenscher & Bachtel 104* (US); *Phelps 282* (GH, US); *Wherry & Muenscher 15308* (GH); *Wiegand 1968* (GH). Pennsylvania: *Fogg 12124* (GH). Maryland: *Hermann 14936* (US). Virginia: *Hunnewell 18931* (GH). New Jersey: *Long 31981* (GH), *37425* (GH), *37478* (GH). Connecticut: *Ebinger 90* (YU); *Parker 5492* (YU); *Weatherby 2403* (YU). Massachusetts: *Hill & St. John 1698* (YU). New Hampshire: *Bissell 1498* (YU); *Edmondson 4189* (GH); *A. H. Moore 3408* (US). Maine: *Fellows 1768* (US), *2368* (US); *Fernald 85* (GH, US, YU), *2510* (GH); *Ricker 180* (US); *St. John & Nichols 2203* (YU, US). Indiana: *Deam 44268* (GH). CANADA: Ontario: *Hosie, Losee & Bannan 1512* (GH); *Dutilly & Lepage 36312* (US); *Montgomery 1069* (GH); *Soper 2652* (GH). Quebec: *Chrysler 1181* (US); *Collins, Fernald & Pease 5462* (GH); *Dutilly & Lepage 15036* (GH); *Rouleau 1689* (GH); *Rousseau 2621* (GH, US); *St. John 1824*

(GH); *Marie-Victorin 28491* (GH); *Marie-Victorin & Rolland-Germain 25793* (GH, US), *27117* (GH), *29264* (GH), *45674* (GH), *47459* (GH). Prince Edward Island: *Fernald & St. John 10988* (GH). Nova Scotia: *Bissell & Linder 20733* (GH); *Fernald & Long 23583* (GH); *Long & Linder 20732* (GH), *20735* (GH); *Nichols 79* (YU), *542* (YU, GH); *Pease & Long 20734* (GH, US). Newfoundland: *Pease & Edgerton 27216* (GH).

Luzula acuminata Raf. var. **carolinae** (S. Wats.) Fern. UNITED STATES: Alabama: *Harper 3703* (GH, US), *3956* (US). Georgia: *Allard 81* (US), *82* (US); *Cronquist 4979* (GH); *D. Eyles 6863* (GH); *Harper 2056* (GH, US), *2062* (GH, US); *Hermann 10186* (GH); *Muenscher & Smith 2954* (GH). South Carolina: *House 1847* (US); *E. J. Palmer 35405* (GH). North Carolina: *Correll 5020* (GH); *Godfrey 3414* (GH), *3814* (GH); *Godfrey, Campana & Fox 48070* (GH); *Godfrey & Fox 50307* (GH); *Godfrey, Fox & Woods 49111* (GH); *Godfrey & White 7013* (GH, US); *Gray & Carey* (July, 1841) (GH-HOLOTYPE); *House 4130* (US); *Hunnewell 10272* (GH), *14188* (GH). Tennessee: *Hunnewell 15158* (GH); *Nease 194* (US). Kentucky:*Mcinterr & Shacklette 615* (US). Ohio: *Leonard 551* (US), *552* (US). West Virginia: *Dickey 244* (GH); *Fosh 1034* (US). Virginia: *Fernald & Long 6958* (GH), *6959* (GH), *6960* (GH), *6961* (GH), *7787* (GH), *7788* (GH), *14526* (GH); *Fernald, Long & Abbe 14123* (GH); *Fernald, Long & Pease 11657* (GH, US), *11658* (GH); *Grimes 3400* (GH).

THE OCCURRENCE OF SPIRODELA OLIGORRHIZA IN THE UNITED STATES

EDWIN H. DAUBS[1]

Spirodela oligorrhiza (Kurz) Hegelm. of the Lemnaceae was first reported and described by Kurz (1867) from India under the binomial *Lemna oligorrhiza*. Shortly thereafter Hegelmaier (1868) transferred the species to the genus *Spirodela*, and reported its further occurrence in Australia and Java. At the same time he also described and named four varieties. Later (1896) he gave each of these varieties species status.

The species remained unreported outside of this Far Eastern area until Saeger (1934) recorded it from two locations in Missouri. The first of these was made by him in Swope Park, Kansas City, and the second by F. H. Woods from a pond in southwestern Missouri. It is also reported that this pond contained goldfish, indicating the probability

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that the plant was introduced from commercial supply sources for domestic aquaria. More recently, Mason (1957) has reported the plant as occurring in the vicinity of Berkeley, California, but without a specific location, and this appears to be another instance of the same nature as reported by Saeger.

Within the past few years however, a considerable number of new collections from widely separated areas have been made. The author has collected this species from six locations in Florida, two in Louisiana, and from one in Illinois. The voucher specimens for these collections are in the Herbarium of the University of Illinois. Also from Florida five collections were reported (personal communication) by Professor R. K. Godfrey and Richard D. Houk.

The specific citations for my own collections are as follows: FLORIDA. — PASCO CO., small pond south of Mazaryktown along U. S. highway 41, Feb. 1, 1961, *Daubs 651;* SARASOTA CO., drainage ditch along Fruitville Road east of Sarasota, Feb. 3, 1961, *Daubs 666;* HILLSBOROUGH CO., ditch along U. S. 301 north of Tampa, Feb. 9, 1961, *Daubs 670;* PASCO CO., pond north of Dade City along U. S. 301, Feb. 9, 1961, *Daubs 671;* SUMTER CO., ditch along roadside near junction of U. S. 301 and Fla. Rd. 42, Feb. 9, 1961, *Daubs 672;* MARION CO., pond near U. S. 301 between Ocala and Pedro, Feb. 9, 1961, *Daubs 673*. LOUISIANA. — ST. CHARLES PARISH, ditch along U. S. 90, 1/2 mile east of Bouette, May 31, 1961, *Daubs 782;* LA FOURCHE PARISH, ditch along U. S. 90, between Raceland and Houma, May 31, 1961, *Daubs 786*. ILLINOIS. — ALEXANDER CO., Horseshoe Lake, Nov. 24, 1960, *Daubs 545;* same location, June 2, 1961, *Daubs 803*.

From California, Dr. L. R. Heckard of the Jepson Herbarium, University of California, Berkeley, reports (personal communication) a collection of *S. oligorrhiza* from Millerton Lake, *Bacigalupi and Heckard 7693*, Apr. 30, 1961, "most certainly naturally occurring" and further remarks, "There must be many more localities in California".

This recent plethora of reports is probably not due to any sudden widespread dissemination of the species but rather to the failure of potential collectors to identify it from eye level, confusing it with *Lemna minor*, to which it is usually similar in size. It can be easily separated from any of the *Lemna* species through the possession of more than one root,

usually 2-4, and from *S. polyrrhiza* which usually has 5-many roots, and is orbicular to obovate in shape, as well as usually much larger in size. It would appear that *S. oligorrhiza,* most probably introduced as indicated, has now become well established in many areas, and will doubtless continue to spread throughout the area to which it is adapted. The plant is not known to produce the familiar overwintering turions found in *S. polyrrhiza,* but it flowers rather readily and the seeds may provide an adequate overwintering form for those areas too cold for vegetative survival.

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PASPALUM FIMBRIATUM IN THE UNITED STATES

DONALD J. BANKS

While searching for plants of the Setacea group of the genus *Paspalum* in southern Florida, I found several plants of *Paspalum fimbriatum* HBK. growing under natural conditions. This annual species is very distinct because of its winged spikelets. It has not been previously reported as occurring in the continental United States. According to Chase (1929), the species has been collected in Panama, the West Indies, northern South America, and the Hawaiian Islands.

Erdman West[1] of the University of Florida reported receiving recently for identification a sample of *fimbriatum* which had been collected in a lawn near Homestead, Dade County, Florida by F. C. Craighead on Sept. 7, 1961 (FLAS *82141*). West remarked that *Paspalum fimbriatum* had been planted in the "old grass garden" at Gainesville and was collected Aug. 19, 1922 by W. E. Stokes (FLAS *3545*)

[1]Personal communication.

but it apparently had not persisted as it was not collected again. According to Swallen[1], Smithsonian Institution, and Godfrey[1], Florida State University, no U.S. specimens are on file in their herbaria. Thus, these Florida collections are probably the first of this species for the continental United States.

My first collection was made on Plantation Key on Sept. 9, 1961. Later that day another collection was made near Florida City, approximately 39 miles from the first site. The following day a single plant was collected near Homestead approximately 7.2 miles northwest of the second site.

It is possible that this species could be a relict. However, since it had not been discovered previously even though considerable plant collecting has been done in Florida, it appears that the species may be a new immigrant. It seems probable that the light winged seeds could have been carried from the West Indies by recent hurricanes. Botanists should look for the species to more adequately determine its distribution.

My collections of *Paspalum fimbriatum* (all from Florida) are as follows:

Roadside on dry coral, Plantation Key, Monroe Co. Associated with *Paspalum caespitosum* Flügge and *Paspalum ciliatifolium* Michx. Sept. 9, 1961. *D. J. Banks 1223;* Miami oolitic limestone 3.2 miles south of Florida City on U. S. Highway no 1, Dade Co. Associated with *Paspalum caespitosum* Flügge. Sept. 9, 1961. *D. J. Banks 1242;* Miami oolitic limestone, approximately 2 miles northwest of Homestead, Dade Co. Associated with *Chloris petraea* Swartz, *Paspalum caespitosum* Flügge, and *Paspalum pubescens* Muhl. Sept. 10, 1961. *D. J. Banks 1260.*

Specimens are being deposited in the herbaria of the Chicago Natural History Museum, Florida State University, University of Florida, University of Georgia, Harvard University, Missouri Botanical Garden, New York Botanical Garden, and the Smithsonian Institution. — DEPARTMENT OF BOTANY, UNIVERSITY OF GEORGIA.

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THE GENUS ANONYMOS AND ITS NOMENCLATURAL SURVIVORS

DANIEL B. WARD

Thomas Walter, in his pioneer descriptive study, *Flora Caroliniana* (1788), named and described over 300 species which he believed to be new to science. A majority of these species truly were new, and Walter's names are of familiar occurrence in articles dealing with the flora of the southeastern United States.

Among his many new species Walter detected representatives of what he considered to be undescribed genera. He recognized 32 of these new genera and placed in them 52 species, about half also new, the rest transfers from other genera. He named four of these genera, containing eight species, in a conventional manner, while he modestly labeled the remaining 28 with the ambiguous pseudonym *Anonymos*.

Although there has never been doubt that Walter intended *Anonymos* to be merely a provisional generic name, there has been dispute as to whether the specific epithets published under this name were available for transfer to more precisely defined genera. In the United States, following the lead of M. L. Fernald and S. F. Blake, modern authors have treated Walter's epithets as legitimate and have recognized their transfer to other genera. But in June, 1950, the Nomenclature Section of the VIIth International Botanical Congress (Stockholm) decreed otherwise, voting that all "binary combinations of a specific epithet with the word Anonymos" were illegitimate.

Illegitimacy of the epithets used by Walter in connection with the provisional name *Anonymos* means, of course, that they are not available for transfer to other genera and Walter cannot properly appear in the conventional author citation of the legitimate name.[1] But illegitimacy does not mean that the same epithet cannot be used for the same

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[1]The Code (Art. 23) does permit the optional inclusion of Walter's name if enclosed in brackets. An alternative and perhaps preferable method of full citation is the use of "ex" beween Walter's name and that of the publishing author (Rec. 46A).

species by a later author; if an epithet from an illegitimate name is used again in a different genus it is treated, not as a transfer, although that may have been the intent of the later author, but for all practical purposes as a new epithet.

Even preceding the vote against *Anonymos* it was realized, as has recently been pointed out again by Wilbur (Rhodora 63:37. 1961), that many of Walter's epithets were transferred to other genera by J. F. Gmelin in his *Systema Naturae*, published in 1791 and 1792, before other authors had occasion to re-describe and rename the same plants. Gmelin, it is true, often failed to provide a specific description, but this requirement for valid publication is fulfilled in the case of monotypic genera by the generic description, abstracted from Walter, and in all cases by reference to Walter and the appropriate specific description. Often validation is further secured by the existence of specimens which may be taken to be types in the John Fraser collection on deposit at the British Museum. The familiar epithets of Walter, then, remain available for those plants where they have been used in the past, the only changes occurring in the author citation.

A few of the epithets transferred by Gmelin resulted in the formation of unfamiliar synonyms such as *Mattuschkia aquatica*, not recognized by him to be based on the long known *Saururus cernuus* L. But 19 of Walter's *Anonymos* epithets, together with a twentieth omitted by Gmelin but picked up by Willdenow, survive to the present in the correct names of members of the Southeastern flora. With the expectation of providing a convenient source for determining the proper citation for these names, the following list has been prepared.

Agalinis setacea (J. F. Gmel.) Raf., New Fl. **2**: 64. 1837, replaces *A. setacea* (Walt.) Raf. (syn. *Gerardia setacea* (Walt.) J. F. Gmel.; *Gerardia* rejected for conservation, Taxon **10**:124. 1961). Basonym (*Gerardia setacea* J. F. Gmel., Syst. **2**:928. 1792) is inadequately described ("G. foliis setaceis, caule ramosissimo, floribus terminalibus"), but is validated by reference to Walter (Fl. Carol. 170. 1788).

Burmannia capitata (J. F. Gmel.) Mart., Nov. Gen. Sp. **1**: 12. 1823, replaces *B. capitata* (Walt.) Mart. Basonym (*Vogelia capitata* J. F. Gmel., Syst. **2**: 107. 1791) lacks specific description, but is validated

by generic description and by reference to Walter (Fl. Carol. 69. 1788).

Crotalaria rotundifolia J. F. Gmel., Syst. **2:** 1095. 1792, replaces *C. rotundifolia* (Walt.) Poir. in Lam. (syn. *C. maritima* Chapm.). Description is inadequate for separation from *C. angulata* Mill. ("Cr. foliis rotundatis integris pilosis sparsis, caule subdecumbente"), but is validated by reference to Walter (Fl. Carol. 181. 1788) and by Walter's type (photo, Rhodora **50:** plate 1107. 1948). *C. rotundifolia* Poir. in Lam. is a later homonym; Poiret (Enc. suppl. **2:** 402. 1812) described a quite different plant and made no reference to Walter or Gmelin.

Cynoctonum sessilifolium J. F. Gmel., Syst., **2:** 443. 1791, replaces *C. sessilifolium* (Walt.) J. F. Gmel. Description is inadequate ("C. foliis sessilibus"), but is validated by reference to Walter (Fl. Carol. 108. 1788).

Dioscorea quaternata J. F. Gmel., Syst. **2:** 581. 1791, replaces *D. quaternata* (Walt.) J. F. Gmel. Description is brief but diagnostic. Reference is made to Walter (Fl. Carol. 246. 1788).

Elytraria caroliniensis (J. F. Gmel.) Pers., Syn. Pl. **1:** 23. 1805, replaces *E. caroliniensis* (Walt.) Pers. (syn. *E. virgata* Michx.). Basonym (*Tubiflora caroliniensis* J. F. Gmel., Syst. **2:** 27. 1791) lacks specific description, but is validated by generic description and by reference to Walter (Fl. Carol. 60. 1788).

Houstonia procumbens (J. F. Gmel.) Standley, N. Am. Flora 32: 26. 1918, replaces *H. procumbens* (Walt.) Standley (syn. *H. rotundifolia* Michx.). Basonym (*Poiretia procumbens* J. F. Gmel., Syst. 2: 263. 1791) has inadequate description ("P. caule procumbente"), but is validated by reference to Walter (Fl. Carol. 86. 1788).

Lachnanthes tinctoria (J. F. Gmel.) Ell., Sketch Bot. S. C. & Ga. **1:** 47. 1816, replaces *L. tinctoria* (Walt.) Ell. Basonym (*Heritiera tinctorium* J. F. Gmel., Syst. **2:** 113. 1791, "tinctorum") lacks specific description, but is validated by generic description and by reference to Walter (Fl. Carol. 68. 1788).

Liatris graminifolia Willd., Sp. Pl. **3:** 1636. 1803, replaces *L. graminifolia* (Walt.) Willd. Description is adequate. Reference is made to Walter (Fl. Carol. 197. 1788).

Lithospermum caroliniense (J. F. Gmel.) MacM., Metasp. Minn. Val. 438. 1892, replaces *L. caroliniense* (Walt.) MacM. (syn. *L. gmelinii* (Michx.) Hitchc.). Basonym (*Batschia caroliniensis* J. F. Gmel., Syst. **2:** 315. 1791) lacks specific description, but is validated by generic description and by reference to Walter (Fl. Carol. 91. 1788).

Micranthemum umbrosum (J. F. Gmel.) Blake, Rhodora **17:** 131. 1915, replaces *M. umbrosum* (Walt.) Blake (syn. *M. orbiculatum* Michx.). Basonym (*Globifera umbrosa* J. F. Gmel., Syst. **2:** 32. 1791, "umbros") lacks specific description, but is validated by generic description and by reference to Walter (Fl. Carol. 63. 1788).

Nymphoides aquatica (J. F. Gmel.) Kuntze, Rev. Gen. **2:** 429. 1891

(as "Nymphodes aquaticum"; Hill (Brit. Herb. 77. 1756) originally spelled the genus "Nymphoides" and treated it as feminine, the gender advised by Rec. 75A of the International Code,) replaces *N. aquatica* (Walt.) Kuntze. Basonym (*Villarsia aquatica* J. F. Gmel., Syst. **2:** 447. 1791) lacks specific description, but is validated by generic description and by reference to Walter (Fl. Carol. 109. 1788).

Petalostemon pinnatum (J. F. Gmel.) Blake, Rhodora **17:** 131. 1915, replaces *P. pinnatum* (Walt.) Blake (syn. *P. corymbosum* Michx.). Basonym (*Kuhnia pinnata* J. F. Gmel., Syst. **2:** 375. 1791) has inadequate description ("K foliis pinnatis"), but is validated by reference to Walter (Fl. Carol. 103. 1788).

Planera aquatica J. F. Gmel., Syst. **2:** 150. 1791, replaces *P. aquatica* (Walt.) J. F. Gmel. Specific description is lacking, but name is validated by generic description and by reference to Walter (Fl. Carol. 230. 1788).

Ruellia caroliniensis (J. F. Gmel.) Steud., Nom. Bot. ed. 2. **2:** 481. 1841, replaces *R. caroliniensis* (Walt.) Steud. (syn. *R. hybrida* Pursh). Basonym (*Pattersonia caroliniensis* J. F. Gmel., Syst. **2:** 925. 1792) lacks specific description, but is validated by generic description and by reference to Walter (Fl. Carol. 168. 1788).

Seymeria cassioides (J. F. Gmel.) Blake, Rhodora **17:** 134. 1915, replaces *S. cassioides* (Walt.) Blake (syn. *S. tenuifolia* Pursh). Basonym (*Afzelia cassioides* J. F. Gmel., Syst. **2:** 927. 1792) lacks specific description, but is validated by generic description and by reference to Walter (Fl. Carol. 171. 1788).

Trilisa odoratissima (J. F. Gmel.) Cass., Dict. Sci. Nat. **55:** 310. 1828, replaces *T. odoratissima* (Walt.) Cass. (*T. odoratissima* (Michx.) Cass.). Basonym (*Chrysocoma odoratissima* J. F. Gmel., Syst. **2:** 1204. 1792) is questionably adequate ("Chr. foliis radicalibus ovato-oblongis; caulinis oblongo-lanceolatis laevibus, floribus corymbosis"), but is validated by reference to Walter (Fl. Carol. 198. 1788).

Trilisa paniculata (J. F. Gmel.) Cass., Dict. Sci. Nat. **55:** 310. 1828, replaces *T. paniculata* (Walt.) Cass. (*T. paniculata* (Michx.) Cass.). Basonym (*Chrysocoma paniculata* J. F. Gmel., Syst. **2:** 1204. 1792) is recognizably described ("Chr. foliis lanceolatis adscendentibus, caulequе viseoso simplici pilosis, paniculata terminali"), and is supplemented by reference to Walter (Fl. Carol. 198. 1788).

Uvularia caroliniana (J. F. Gmel.) Wilbur, Rhodora, **63:** 39. 1961, replaces *U. pudica* (Walt.) Fern. (syn. *U. puberula* Michx.). Basonym (*Erythronium carolinianum* J. F. Gmel., Syst. **2:** 546. 1791) lacks specific description, but is validated by reference to Walter ("Anonymos pudic", Fl. Carol. 123. 1788).

Zornia bracteata J. F. Gmel., Syst. **2:** 1096. 1792, replaces *Z. bracteata* (Walt.) J. F. Gmel. Specific description is lacking, but name is validated by generic description and by reference to Walter (Fl. Carol. 181. 1788).

The remaining 24 new names, of the 44 created by Walter by the combination of an epithet with *Anonymos*, appear not to have been used as basonyms by later authors. This neglect is justified since all are either (a) synonyms of earlier names, (b) homonyms resulting from the improper application of an earlier name, or (c) not clearly identifiable. They are listed and tentatively identified below, to complete the disposition of Walter's *Anonymos* epithets.

aquatic[a] (p. 127)	*Saururus cernuus* L.
aquatic[a] (p. 137)	*Decodon verticillatus* (L). Ell.
caroliniensis (p. 164)	probably *Verbena canadensis* (L.) Britt.
caroliniens[is] (p. 188)	*Amphicarpa bracteata* (L.) Fern.
caroliniensis (p. 263)	possibly *Hydnum erinaceus* Bull.
ciliat[a] (p. 197)	possibly *Liatris* although not so recognized by Gaiser (Rhodora 48:165-183, 216-382, 393-412. 1946)
corymbos[a] (p. 139)	possibly *Vaccinium myrsinites* Lam., or *V. tenellum* Ait., not *Vaccinium corymbosum* L. according to range given by Camp (Brittonia 5:260. 1945)
erect[a] (p. 86)	*Houstonia caerulea* L.
erect[a] (p. 170)	identified by Pennell (Scroph. of E. Temp. N. A., 473. 1935) as either *Agalinis (Gerardia) linifolia* (Nutt.) Britt., *A. obtusifolia* Raf., or *A. tenella* Pennell
flava (p. 170)	*Aureolaria flava* (L.) Farw.
frondos[a] (p. 139)	*Gaylussacia frondosa* (L.) Torr.
frutescens (p. 186)	*Wisteria frutescens* (L.) Poir. in Lam.
ligustrin[a] (p. 139)	*Lyonia ligustrina* (L.) DC.
pedicularis (p. 170)	probably *Aureolaria pectinata* (Nutt.) Pennell
petiolat[a] (p. 108)	*Cynoctonum mitreola* (L.) Britt.
pilos[a] (p. 197)	possibly *Liatris* although not so recognized by Gaiser (*op. cit.*)
purpurea (p. 170)	*Agalinis purpurea* (L.) Pennell
quinat[a] (p. 246)	probably *Dioscorea quaternata* J. F. Gmel., according to Anderson (Rhodora 36:345. 1934)
ramos[a] (p. 198)	possibly *Liatris* although not so recognized by Gaiser (*op. cit.*)
repens (p. 110)	*Dichondra carolinensis* Michx.
repens (p. 160)	*Phyla nodiflora* (L.) Greene
sagittalis (p. 181)	*Crotalaria sagittalis* L.
sempervirens (p. 98)	*Gelsemium sempervirens* (L.) Ait. f.

uniflor[a] (p. 198)	probably *Carphephorus bellidifolius* (Michx.) T. & G. or *C. tomentosus* (Michx.) T. & G.

— UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA.

NOTE: After the manuscript for the above paper was submitted to the editor, Dr. R. L. Wilbur of Duke University very generously made available to me his independently prepared manuscript on the same subject. I have made a few changes and corrections in the present paper, as suggested by his studies and our subsequent correspondence. A new combination proposed by Dr. Wilbur has been left for his later treatment. — D. B. W.

JOHN BACHMAN AND THE HAPPOLDT EUROPEAN JOURNAL. — Reverend John Bachman is remembered as a close associate of Audubon for he ably assisted in the writing of both *Birds of America* and *Quadrupeds*, and the two families were united by Bachman's two daughters marrying Victor and John Woodhouse Audubon. Less familiar is Bachman's own interest in botany. In 1835 he published a fifteen-page check-list of 1030 species entitled *Catalogue of Phanerogamous plants and ferns, native or naturalized, found growing in the vicinity of Charleston, South-Carolina.* When Hooker's friend, William A. Bromfield, visited America, ne spent about five weeks in Charleston in 1847 and often saw Bachman. On February eleventh Bromfield "went to Rev. Dr. Bachman's to look over Elliott's herbarium with Mr. Ravenel of St. John's who has made an extensive collection of the species about the place. Dr. Bachman drove me out 8 miles from Charleston to look for *Ulmus alata* in flower." Some of Bachman's specimens are lodged at the Academy of Natural Sciences, Philadelphia, via the Short Herbarium, and others are in the Durand Herbarium at Paris, but his own herbarium, along with a valuable library (including a copy of Catesby's *Natural History*), was burned in Columbia, whence it had been moved for safe-keeping, at the time of Sherman's raid.

Bachman at twenty-five had come to Charleston from Pennsylvania in 1815 and the following year married Harriet Martin, daughter of a Charleston parson. Harriet's sister was Maria Martin who drew many botanical backgrounds

for Audubon's bird plates. After Harriet's death the Reverend Bachman married Maria.

Though it is not evident from the title[1] this "Contribution" from the Charleston Museum contains much of interest to any reader with a curiosity about South Carolina natural history. The index is helpful though not exhaustive. More valuable in some connections than the journal is the eighty-nine page biography of Bachman prepared by Professor Claude H. Neuffer, of the Department of English, University of South Carolina, who "discovered" and edited the journal.

Christopher Happoldt (1823-1878), soldier-surgeon, was a protegé of Reverend John Bachman, and the journal kept by young Christopher, aged fifteen, concerned a six months' tour of Europe, June 5 to December 27, 1838, while acting as a travelling companion during Bachman's convalescence on a recuperative sea voyage. Bachman was nearing the zenith of an active scientific life, all the while fulfilling his duties faithfully as minister at St. John's Lutheran Church. He had assisted Audubon assiduously during several years past. There are 134 references to Bachman's aid in *Ornithological Biography* alone. To combat a general debility enhanced in part by a mild attack of cholera in 1836, it had been decided that a tour of Europe, including a chance to visit Audubon then busily working in Edinburgh with Macgillivray, would be refreshing for the pastor. Leaving Charleston on the *Chicora* for Liverpool, young Happoldt and Reverend Bachman arrived at No. 4 Wimpole Street, the Audubons' London Home, to be greeted by Lucy and the family, and to be off for Edinburgh within two weeks. So begins what amounts to a lively if somewhat repetitive diary by a frank young man viewing the European scene.

Upon completing his medical education abroad, Dr. Happoldt practiced in Charleston and edited the local medical *Journal and Review*. However this was not to last long because, on his wife's insistence, he moved to Morgantown, North Carolina, and passed from the professional spotlight to the obscurity of a country doctor. He later served the

---

[1]*Christopher Happoldt Journal.* Edited by Claude Henry Neuffer. Charleston Museum, Charleston, S. C., 1961. p. 214 [plus 14 unnumbered index pp.] $5.00 ppd.

Confederacy, and then the citizens of Vicksburg when a yellow fever outbreak struck that river city. There he died "the victim of the disease he had fought against so valiantly in order that others might live."

The Happoldt diary is of particular interest for its fleeting glimpses of personalities and places. There is Dr. Frank Buckland of Oxford; the Prince of Massena, a devotee of natural history; "Prof. Braum of Carlsbruche" [Heinrich Georg Bronn, 1800-1862, who translated Darwin's *Origin*]; Dr. J. C. Faber of Charleston and James Trudeau of New Orleans, both then visiting Paris; and such institutions as the Jardin des Plantes in Paris and Knowsley Hall near Liverpool where Bachman met the Earl of Derby for whose zoo he had transported live anhingas across the Atlantic! Yes, they saw the Queen in London town, attended by the royal family, and her some 1500 Swiss guards "all mounted on black horses."

Young Christopher sampled dolphin roe for dinner and pronounced it "certainly very fine." At Regent Park Zoo there were three thousand persons on Sunday, July 8th, "not," as he observed, "for the purpose of seeing the animals but the company." In true adolescent form, Christopher paled at the succession of museums, and when Bachman visited the Tower, he did not go "because he did not like to see everything twice." However, his sage verdict finally was:

"I find it a great use to Travel, the man who remains home all his life, has no idea of mankind; either of the Improvements of the world." — JOSEPH EWAN, TULANE UNIVERSITY.

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COMMENT FROM THE NEW EDITOR

It should be pointed out that the January-March 1962 number of Rhodora was edited entirely by Professor Reed Rollins, who volunteered to continue his services during the critical period of transition. This seems to have been a wise solution, because much of the editing of this number had been accomplished when the change in editors was made. I much appreciate Professor Rollins' willingness to help out in this way to bridge the gap.

It is particularly reassuring to me to have nearly all of the experienced editorial board continuing to serve, for much of the quality of the journal is attributable to their critical attention and judgment.

Since Rhodora, for the first time, is being edited at some distance from Cambridge, it was felt that the selection of a new associate editor from my colleagues at the University of New Hampshire would do much to facilitate my work. Mr. Radcliffe Pike, who has worked with me for many years in botanical investigations, has consented to serve on the board.

Professor Rollins, in my opinion, during his twelve years as editor has very wisely broadened Rhodora, both as to geographical coverage and the range of subject matter. But because of this very broadening, the Gray's Manual Area and New England should continue to provide abundant material for new insights and interpretations. It is hoped that botanists interested in the more local area will have a resurgence of activity in the years ahead. — A. R. HODGDON

SOME ADDITIONS TO THE FLORA OF GRAND MANAN ISLAND, NEW BRUNSWICK

A. R. Hodgdon and Radcliffe B. Pike

The Vascular Flora of Grand Manan was excellently presented by Weatherby and Adams in 1945 (1) and has served as an admirable source of reliable information relating to our current floristic study of the nearby Wolf Islands and other islands in the Bay of Fundy.*

In connection with our work a number of questions had arisen that bore directly on Grand Manan, so in July 1961 we visited Grand Manan and Long Island for parts of two days and in August returned for three days of active botanizing on the main island as well as on Outer Wood and White Head Islands. One of our main projects was to determine whether a considerable number of taxa that we had found on the Wolf Islands but which Weatherby and Adams had not reported from Grand Manan, actually were absent there. This turned out to be true so far as our observations and collections were concerned, thus confirming our opinions that a fairly thorough canvass had been made of the Grand Manan flora. However, as a by-product of our work, a number of new records were compiled as well as one somewhat questionable record confirmed. These additions will now be considered along with a few problems that still invite further study.

Lycopodium tristachyum Pursh. — On the evening of August 21 while on our successful search for *Pinus resinosa*, we encountered a dry somewhat sandy area with a sparse growth of *Vaccinium myrtilloides*, *Kalmia angustifolia*, *Rhododendron canadense* and associated species. Here we found a few individuals of this clubmoss with its characteristically deeply embedded rhizomes. Though lacking strobili there seems to be no question about its identity.

*This research is part of a project entitled "Floristic and Phytogeographic Investigations of the Wolf Islands and other islands in the Bay of Fundy which was supported by a grant from the Central University Research Fund of the Graduate School of the University of New Hampshire.

Published with the approval of the Director of the New Hampshire Agricultural Experiment Station as Scientific Contribution No. 285.

Specimens of this and other taxa listed here as additions to the flora of Grand Manan, unless especially noted, are deposited in the Gray Herbarium and in the Herbarium of the University of New Hampshire.

Tsuga canadensis (L.) Carr. — Hemlock was included in the "Flora" on the strength of Allan Moses' report of a single tree in the ravine of Dock Brook. There is little reason to doubt this record but we were unable to find any hemlock trees though we scrutinized Dock Brook and its environs carefully except for a short lower section. It is perhaps more surprising that hemlocks are not more prevalent on Grand Manan. It is of some significance certainly that, during our search for Red Pine, on August 21 we collected a branch of *Rhododendron canadense* with its leaves conspicuously infected with a rust which has been identified by Dr. Avery Rich, Plant Pathologist at the University of New Hampshire as *Pucciniastrum myrtilli* (Schum.) Arth. The alternate host of this rust is *Tsuga canadensis*. Presumably further search for hemlock should be carried on in this part of the island. This specimen of rust is in the mycological herbarium at the University of New Hampshire.

Pinus resinosa Ait. — Weatherby and Adams loc. cit. p. 77 placed this taxon in their list of "Doubtful and Unverified Records" attributing it to Perkin's list. They stated of this record as follows "very likely correct, though the soils of Grand Manan are not such as the red pine prefers."

We first heard of the possible occurrence of red pine in July from Mrs. Earl Green of Grand Harbour. She told us that her father a Mr. Cheney knew of some "different pines" and that she could find someone to direct us to specimens of them. We much appreciate her assistance in providing us with the services of Terrance Ingalls, a very energetic and intelligent boy from Grand Harbour, who on August 21, led us to a number of fine trees of *Pinus resinosa* a short way inland from Grand Harbour. There were several scattered trees of good size varying from one to two feet dbh. Seedlings were observed in the vicinity of the

larger trees but no intermediate small specimens were noted. These pines were scattered over a sufficiently wide area to lead one to hope that some of them may continue to survive there for many years to come.

Eleocharis tenuis (Willd.) Schultes var. *tenuis*. Toward the end of our unsuccessful search for hemlocks along Dock Brook we didn't want to return empty handed so our attention wandered to other things. In a moist opening along a wood-road we saw a fine growth of *Eleocharis* growing with *Juncus articulatus*. After very careful examination our specimens, which are in good fruiting condition, prove to be *E. tenuis* var. *tenuis*. *E. elliptica* Kunth resembles *E. tenuis* in some of its vegetative characteristics and in its general appearance and it has been collected on Grand Manan. The achenes of the two species are very distinct, those of *E. elliptica* being pronouncedly yellow while those of *E. tenuis* are olivaceous and smaller. The tubercule also is less compressed in *E. tenuis*. We compared our material carefully with the specimen of *E. elliptica* from Grand Manan and with reliable specimens of both *E. elliptica* and *E. tenuis* in the New England Botanical Club Herbarium.

Betula papyrifera Marsh var. *cordifolia* (Regel) Fernald. — Weatherby and Adams loc. cit. p. 41 listed no variety of this species nor made any comment about its variability on Grand Manan. Fernald's treatment of the series *Albae* in eastern North America (2) appeared at about the same time that the Grand Manan Flora first came out in the autumn of 1945. For this reason Mr. Weatherby may not have been stimulated to study birches very closely during the years preceding this when he was actively investigating the flora. Most of the *Betula papyrifera* of Grand Manan is whitish barked but in 1955 the junior author noted a birch of this variety with dark bark and abundant catkins along the road to the Whistle House. At that time the area was densely wooded.

On August 23, 1961 we revisited this locality, which had been lumbered for the conifers in the interim, finding many of the birches in question with abundant catkins, dark

bark and leaves mostly cordate-based. We took specimens from ten trees which we hope to study later along with similar population samples which we have from the Wolf Islands and Lubec, Maine.

Thlaspi arvense L. — A specimen in fruit with no leaves was collected by us at Dark Harbour on August 22, 1961. We have noticed in examining the Weatherby and Adams list that several very common and widespread weeds and introduced plants have not yet been reported. This and the taxon to follow will help to augment the list of introductions. Specimens of these are to be found in the herbarium at the University of New Hampshire.

Raphanus raphanistrum L. forma *sulphureus* (Babey) Hayek. — Since Weatherby and Adams often reported conspicuous forms in other groups it is appropriate to record this one which we collected at Dark Harbour.

Rubus canadensis L. — Weatherby and Adams loc. cit. p. 52 state that *R. canadensis* L. is "the common high-bush blackberry of the island." In August 1955 the junior author and Dr. Donald L. Craig of Kentville, Nova Scotia (3), who then was working with *R. canadensis* at the University of New Hampshire, spent several days on Grand Manan searching for good material of that species. Following the interpretation of Bailey (4) and that of Fernald (5) of *R. canadensis*, good material was conceived of as being essentially without prickles, comparable in this respect to the usual specimens of *R. canadensis* that are so common in northern New England and in cooler mountainous areas farther to the south. Surprisingly a very small percentage of the specimens seen in the summer of 1955 qualified as typical *Rubus canadensis*. Most of the plants were of varying degrees of prickliness, in this respect fitting either *R. amicalis* Blanch. or *R. elegantulus* Blanch. as these are interpreted by Fernald (5). But it is to be noted that Weatherby and Adams, loc. cit. p. 53 relied on Bailey for the identification of their blackberries. Bailey's treatment of *R. canadensis* in 1944 was a peculiar one particularly in the light of his usual tendency to split the species as finely

as possible. After a preliminary delineation of *R. canadensis* as an essentially smooth blackberry, he combined *R. elegantulus* with it as only "a small and usually slender phasis" (see Bailey loc. cit. p. 475). The Grand Manan plants present a particular problem because they combine the prickliness of *R. elegantulus* and *R. amicalis* with the features that are commonly associated with *R. canadensis* including large size and strongly racemose inflorescences. Except for the degree of prickliness, most of the bigger plants certainly resemble *R. canadensis*.

— DEPARTMENT OF BOTANY AND DEPARTMENT OF HORTICULTURE, UNIVERSITY OF NEW HAMPSHIRE, DURHAM, NEW HAMPSHIRE

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CYTOLOGICAL OBSERVATIONS OF POLYGALA IN EASTERN NORTH AMERICA

Walter H. Lewis and Shirley A. Davis[1]

For a genus of over 450 species, of which no fewer than 200 are described in North and Central America, only 15 species of *Polygala* have been studied cytologically. No New World species are included in this meager total.

Unfortunately, the *Polygala* material is not particularly favorable for study. At meiosis the greatest difficulty is the low number of pollen mother cells formed in each anther, giving few figures for observation when a satisfactory stage is obtained. Under these circumstances, we have found that much more fixed bud material must be

[1]Undergraduate Research Participant, National Science Foundation G-12059.

collected for results than is usual for most genera. When to this need is added the paucity of plants at any one locality, particularly for those species endemic to the Mexican highlands where the greatest number of North American species occur, it is apparent why this feature limits chromosomal research. The meiotic process also is a hindrance. Although prophase I appears to be of unusually long duration, we agree with Glendinning (1960) that diakinesis is deceptive in that some chromosomes are still very poorly stained. The most satisfactory stages between prometaphase I and telophase I, however, are completed in very short periods of time which markedly decrease the chance of locating satisfactory figures. Complete restitution nuclei are formed only to be followed in rapid sequence by the phases of meiosis II. Finally the chromosomes of most species are very small and high in number.

A list of reported chromosome numbers in *Polygala* has been compiled (Table 1). Five of the 15 species have been examined by two or more authors, but except for *P. myrtifolia* L. none of these has been given the same chromosome number. This is perhaps the best illustration of the technical difficulties to be encountered in *Polygala*. The 3 African species listed have a basic number of $x = 19$ which are according to Larsen (1959) secondary diploid species probably of tribasic origin from $6 + 6 + 7$ stocks. The single Asian species, *P. japonica* Houtt., has $n = 21$ chromosomes and may be a hexaploid species with a base of $x = 7$. As many as 73% of the European species counted have basic numbers of $x = 17$. As noted in Table 1, the reports are not unanimous for species considered in this series, but the numerous counts from several localities made by Glendinning (1960) outweigh the evidence of earlier authors. It cannot be overruled, however, that chromosmal races may exist for a single species, so that *P. amara* L. may have an $n = 14$ race in eastern Europe (Baskay, 1956; Skalińska *et al.*, 1959) and an $n = 17$ race in western Europe (Glendinning, 1960). The remaining European species have basic numbers of $x = 7$, 8, and 23 (Table 1).

Of other genera in the Polygalaceae records exist for only

4 species, one each in *Atroxima, Bredemeyera, Carpalobia,* and *Securidaca.* These are *A. liberica* Stapf., $2n = 18$ (Mangenot and Mangenot, 1957) *B. colletioides* Phil., $2n = 14$ (Covas and Schnack, 1946), *C. lutea* G. Don, $2n = 20$ (Mangenot and Mangenot, 1957), and *S. longipedunculata* Fres., $2n = 32$ (Mangenot and Mangenot, 1958; Miège, 1960).

MATERIALS AND METHODS

From 39 collections of immature flower buds made from localities in the eastern United States and Mexico, chromosome numbers for 24 species of *Polygala* are reported. The buds were fixed in the field in modified Carnoy's solution (4: 3: 1) and shortly thereafter were stored in the refrigerator for periods up to 6 months before squashing in 1% acetic-orcein. The results are mostly from the study of pollen mother cells or more rarely from premeiotic mitosis. The chromosome number reported for each species is when possible based on the study of more than one plant from several localities. Voucher specimens were obtained for each collection. A complete set has been filed at the Southern Methodist University herbarium (SMU), except for a few which are deposited elsewhere as indicated in Table 2. Duplicates of most collections are filed at the University of Texas herbarium (TEX). We wish to thank the curators of these herbaria for accepting specimens for permanent accession and we especially appreciate receiving fixed material of 3 species from Dr. Robert Kral, Virginia Polytechnic Institute, Blacksburg.

RESULTS

The gametic chromosome numbers for 24 species of *Polygala* are listed by sections (Blake, 1924) in Table 2. Most of the data are based on distinct figures giving definite counts, although the numbers for a few species are only approximations. With rare exceptions (*P. praetervisa* Chod., fig. 11), meiotic behavior was regular. The chromosomes of all species were found to be generally small with the smallest in the sections *Hebeclada* (fig. 5), *Monninopsis* (fig. 15), and *Timutua* (fig. 3, 10, 11, 14), and the largest

in the section *Timutua* (fig. 2, 7-9). Chromosomes of individual karyotypes often varied from very short to intermediate in length as shown by the mitotic chromosomes of *P. reducta* Blake (fig. 13).

The most striking result was the diversity of chromosome numbers for such a small fraction of species. Numbers ranging from $2n = 16$ for *P. scoparia* HBK. to 2n = ca. 104 (108) for an undescribed Mexican species related to *P. alba* Nutt. represent both the lowest and the highest numbers known in the genus. Basic numbers were equally as variable. The species are separable into a primary aneuploid series with basic numbers of $x = 6(12)$, $7(14)$, 8, and 10, and a secondary basic series of $x = 15$, 17, and 23. Probably the closely related *P. cruciata* L. and *P. chapmanii* T. & G. with $n = 18$ and 36, respectively, represent species in still another series of $x = 9$, but until further research reveals the existence of species with 9 haploid chromosomes or until some other evidence is presented, all species having chromosome multiples of 6 are grouped in the $x = 6(12)$ line.

Common to species in the sections *Monninopsis* and *Timutua*, the basic number of $x = 17$ includes about 30% of the species studied. The tetraploid species are slightly more common than the diploids. The basic number of $x = 6$ was also shared by species in these sections. Species with $x = 7$ are distributed in 3 sections, *Eurhinotropis*, *Hebeclada*, and *Timutua*, which illustrates a greater degree of morphological diversity than do species of other basic series in eastern North America. The $x = 8$ and 10 lines are represented by one species each in the sections *Monninopsis* and *Timutua*.

Since at least 4 primary basic numbers are reported for *Polygala*, the secondary dibasic and tribasic lines may have arisen in a number of ways. The $x = 15$ group, common to 2 species in the section *Microthrix*, could have formed from species with $n = 7$ and 8 or, providing stronger evidence is found for the existence of an $x = 9$ series, 6 and 9 chromosomes. In view of the chromosomal diversity recorded by this small sample, it is not inconceivable that these species are unibasic polyploids at the $6x$ and $12x$ levels of an $x = 5$

series. There is less doubt that the $x = 17$ series is of dibasic origin and it may have formed by hybridization of species with 7 and 10 or 8 and 9 haploid chromosomes. The single species with $x = 23$, *P. nuttallii* T. & G., is most probably of tribasic origin and numerous combinations exist in species of the same section to give the necessary chromosomal complement. Without experimental evidence and with only limited counts in the genus as a whole, it is far too speculative at the present time to suggest definite origins for the secondary lines.

The levels and frequencies of ploidy exhibited by the 24 North American species are summarized as follows: primary diploids, 5% ; secondary diploids, 21% ; primary polyploids, 53% ; and secondary polyploids, 21%. Since the secondary diploids are probably all amphidiploids, this gives a total polyploid frequency of 95% or a markedly higher one than the average of 30-35% estimated for the angiosperms in general (Stebbins, 1938). These data are tabulated in Table 3 by basic chromosome number, except that species no. 4 (Table 2) is omitted.

DISCUSSION

Although the total number of species studied is only 39, it is sufficiently large to show the importance of polyploidy in addition to hybridization and aneuploidy in the phylogeny of *Polygala*. The numerical modifications have been so extensive, however, that they have obscured the original chromosome number of the genus. The most frequent number, $x = 17$, can be derived from several primary lines and gives no direct evidence of the composition of the original complement. The numbers of $x = 7$, 8, 9, and 10, in four

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FIGURES 1-16. Chromosomes of *Polygala*, drawn with the aid of a camera lucida at × 2300 reduced by ca. 1/3 in reproduction. Fig. 1. *P. alba*, $n = 12$, *Lewis 5537;* fig. 2. *P. chapmanii*, $n = 36$, *Lewis 5690;* fig. 3. *P. cruciata*, $n = 18$, *Lewis 5692;* fig. 4. *P. curtissii*, $n = 20$ (1 side of metaphase II), *Kral 13817;* fig. 5. *P. grandiflora*, $n = 14$, *Lewis 5680;* fig. 6. *P. scoparia*, $2n = 16$, *Lewis 5753;* fig. 7. *P. mariana*, $n = 17$, *Lewis 5625;* fig. 8. *P. nana*, $n = 34$, *Lewis 5654;* fig. 9. *P. nuttallii*, $n = 23$, *Kral 13791;* fig. 10. *P. polygama* var. *obtusata*, $n = 28$, *Lewis 5621;* fig. 11. *P. praetervisa*, $n = 48$ (as $46_{II} + 1_{III} + 1_{I}$), *Lewis 5667;* fig. 12. *P. ramosa*, $n = 34$ (1 side of anaphase I), *Lewis 5691;* fig. 13. *P. reducta*, $2n = 30$, *Lewis 5757;* fig. 14. *P. rugelii*, $n = 34$, *Lewis 5681;* fig. 15. *P. scoparioides*, $n = 17$, *Lewis 5545;* fig. 16. *P. verticillata* var. *isocycla*, $n = 17$ (1 side of metaphase II), *Lewis 5628*.

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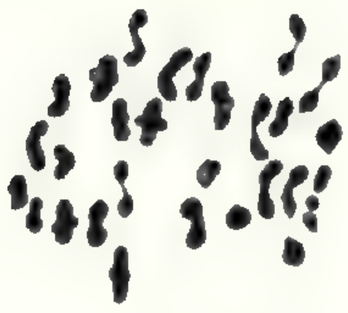
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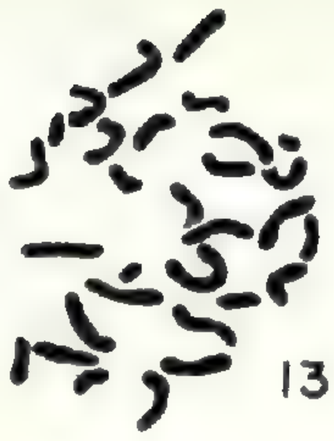
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other polygalaceous genera are too limited to suggest a trend. Even though the series with $x = 7$ includes just 7 species, they are native to Asia, Europe, and North America, to give in total the most extensive distribution of any series. In addition, these species are classified in 5 sections and represent the most diverse morphology of any series. Further research may suggest a different conclusion, but the evidence now available supports $x = 7$ as the original basic number for *Polygala* and probably for the family. The origin of the $x = 6$ line can be postulated on the basis of chromosomal loss and the $x = 8$, 9(?), and 10 groups by chromosomal gain from 7.

A suggestion of the antiquity of the primary aneuploid lines is found in the widespread occurrence of the $x = 17$ stock in the modern flora. A majority of the European and southeastern North American species now known have this number in common. It is reasonable to speculate that the species with $x = 17$ had a single origin and that migration around the North Atlantic, when it was effectively possible in the early Tertiary (Axelrod, 1960), established the group in both continents. Alternately, the number could have arisen independently, but the chance of forming a derived stock twice with both giving rise to parallel lines of descent of about equal significance and success in two continents seems much less probable. If the $x = 17$ series had formed in either Europe or North America by the early Tertiary, then the basic aneuploid differentiation must have occurred in the Cretaceous or earlier. The great antiquity of the primary series may account to some extent for the loss of most of the diploid species (1 out of 39 species) and for the high level of polyploidy reached by the $x = 6$ ($16x$) and 7 ($12x$) groups. In the secondary aneuploid lines, unquestionably of more recent origin, about one-half of the North American species are diploids and all polyploids are only $4x$. — DEPARTMENT OF BIOLOGY, STEPHEN F. AUSTIN STATE COLLEGE, NACOGDOCHES, TEXAS.

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Table 1. Chromosome numbers reported for the Old World *Polygala*.

Taxon	*n*	2*n*	Author
AFRICA			
P. myrtifolia L.	19	. .	Larsen (1959)
P. myrtifolia L.	. .	ca. 38	Glendinning (1960)
P. triflora L.	19	. .	Hagerup (1932)
P. virgata Thunb. var. *speciosa* (Sims) Chod.	. .	38	Larsen (1959)
ASIA			
P. japonica Houtt.	. .	42	Suzuka (1950)
EUROPE			
P. alpestris Rchb.	17	ca. 34	Glendinning (1960)
P. alpina Perr. & Song.	. .	ca. 34	Glendinning (1960)
P. amara L.	14	. .	Baksay (1956)
P. amara L. subsp. *amarella* Cr.	17	34	Glendinning (1960)
P. amara L. subsp. *brachyptera* (Chod.) Hay.	. .	28	Skalinska *et al.* (1959)
P. calcarea Schultz	17	34	Glendinning (1960)
P. chamaebuxus L.	. .	38	Mattick (1950)
P. chamaebuxus L.	22, 23, 24	. .	Glendinning (1955)
P. chamaebuxus L.	. .	ca. 46	Glendinning (1960)
P. comosa Schkr.	. .	28-32	Mattick (1950)
P. comosa Schkr.	. .	28	Larsen (1956)
P. comosa Schkr.	17	34	Glendinning (1960)
P. major Jacq.	. .	32	Mattick (1950)
P. nicaensis Risso subsp. *corsica* Graebn.	. .	34	Contandriopoulos (1957)
P. serpyllifolia Hose.	17	34	Glendinning (1960)
P. vayredae Costa	. .	28	Glendinning (1960)
P. vulgaris L.	24-28	. .	Wulff (1938)
P. vulgaris L.	. .	ca. 70	Löve & Löve (1944)
P. vulgaris L.	. .	28, 32, ca. 56	Mattick (1950)
P. vulgaris L.	34	68	Glendinning (1960)

Table 2. Chromosome numbers for 24 North American species of *Polygala*.

Taxon	Gametic Number (*n*)	Voucher
Section *Eurhinotropis*		
P. tweedyi Britt.	ca. 14	TEXAS. San Patricio Co., 2.1 miles NW of Mathis, *Lewis & Jones 5583* (1).[c]
Section *Hebeclada*		
P. grandiflora Walt.	14	FLORIDA. Glades Co., 8.6 miles SE of Palmdale, *Lewis 5680* (3).

Taxon	Gametic Number (n)	Voucher
Section *Microthrix*		
P. ovatifolia Gray	28-30[a]	TEXAS. San Patricio Co., 2.1 miles NW of Mathis, *Lewis & Jones 5586* (1).
P. reducta Blake	15[a]	NUEVO LEON. 15.2 miles E of Hwys. 57 and 60 junction, *Lewis 5757* (2).
P. scoparia HBK.	8[a]	NUEVO LEON. 11 miles E of Hwys. 57 and 60 junction, *Lewis 5753* (4).
P. scoparioides Chod.	17	TEXAS. Brewster Co., Big Bend National Park, Chisos Mts., *Lewis 5545* (1); Panther Junction, *Lewis 5466* (1).
P. sp. (1)[b]	12[a]	NUEVO LEON. 9.9 miles E of Hwys. 57 and 60 junction, *Lewis 5746* (1, US).
Section *Timutua*		
P. alba Nutt.	12	TEXAS. Brewster Co., Big Bend National Park, *Lewis & Oliver 5455* (2); Culberson Co., North McKittrick Canyon, *Lewis 5537* (2).
P. boykinii Nutt.	ca. 14[a]	FLORIDA. Dade Co., Homestead, *Lewis 5676* (1).
P. chapmanii T. & G.	36	MISSISSIPPI. Hancock Co., 0.5 miles W of St. Louis Bay & Hwy. 90, *Lewis 5690* (2).
P. cruciata L.	18	MISSISSIPPI. Hancock Co., 6.2 miles ENE of Pearl River and Hwy. 90, *Lewis 5692* (3); VIRGINIA. Brunswick Co., 10.5 miles WNW of Emporia, *Kral 13633* (2, VPI).
P. curtissii Gray	20	VIRGINIA. Southampton Co., 8 miles E of Emporia, *Kral 13817* (2, VPI).
P. lutea L.	34	MISSISSIPPI. Hancock Co., 0.5 miles W of St. Louis Bay and Hwy. 90, *Lewis 5689* (1).
P. mariana Mill.	17	TEXAS. Hardin Co., Kountze Lookout Tower, *Lewis 5629* (2); Jasper Co., 50 yds. S of Hwys. 96 and 1004 junction, *Lewis 5625* (1); Polk Co., 3 miles SW of Barnum, *Lewis 5633* (2); San Augustine Co., 0.7 miles SW of Boykin Spring entrance and Hwy. 63, *Lewis & Oliver 5511* (1).
P. nana (Michx.) DC.	34	FLORIDA. Citris Co., 0.4 miles N of Citris Co.-Hernando Co. line and Hwy. 19, *Lewis 5654* (2); TEXAS. Jasper Co.,

Taxon	Gametic Number (n)	Voucher
		50 yds. S of Hwys. 96 and 1004 junction, *Lewis 5623* (2); Newton Co., 4.7 miles S of Newton, *Lewis 5619*.
P. nuttallii T. & G.	23	VIRGINIA. Nansemond Co., N of Cleopus, *Kral 13791* (1, VPI).
P. polygama Walt. var. *polygama*	28	TENNESSEE. Polk Co., 1 mile N of Hwys. 64 and 30 junction, *Lewis 5640* (1).
P. polygama Walt. var. *obtusata* Chod.	28	GEORGIA. Henry Co., 10 miles N of Griffen, *Lewis 3648* (3); TEXAS. Hardin Co., 1.4 miles SE of Votaw, *Lewis 5631* (2); Newton Co., 2.5 miles N of Burkeville, *Lewis 5616* (1), 2.8 miles S of Newton, *Lewis 5621* (1).
P. praetervisa Chod.	48	FLORIDA. Monroe Co., Big Pine Key, *Lewis 5667* (1).
P. ramosa Ell.	34	MISSISSIPPI. Hancock Co., 6.2 miles ENE of Pearl River and Hwy. 90, *Lewis 5691* (4).
P. rugelii Shuttlw.	34	FLORIDA. Glades Co., 8.6 miles SE of Palmdale, *Lewis 5681* (1).
P. verticillata L. var. *isocycla* Fern.	17	TEXAS. Hardin Co., Kountze Lookout Tower, *Lewis 5628* (3); Nocogdoches Co., 0.6 miles E of Martinsville, *Lewis 5723* (1); Panola Co., 2.3 miles NE of Pinehill, *Lewis 5720* (2).
P. sp. (2)[b]	ca. 42[a]	NUEVO LEON. 11 miles E of Hwys. 57 and 60 junction, *Lewis 5754* (1, US).
P. sp. (3)[b]	ca. 36	OAXACA. N of Huaguapan de Leon, *Oliver 136* (1, US).
P. sp. (4)[b]	52-54[a]	COAHUILA. 3.1 miles N of Los Llanos, *Lewis 5728* (2, US).
P. sp. (4)	ca. 52[a]	NUEVO LEON. 15.2 miles E of Hwys. 57 and 60 junction, *Lewis 5755* (1, US).

[a]Based on the somatic number of premeiotic cells.
[b]Probably represent new species to be discussed in a subsequent paper.
[c]Number of plants examined for the chromosome number.

Table 3. Basic chromosome numbers and levels of ploidy with numbers of species by sections for 23 North American species of *Polygala*.

Basic number	Ploidy	Number of species	Section
$x = 6$	$4x$	2	*Monninopsis, Timutua*
	$6x$	1	*Timutua*

	$12x$	2	*Timutua*
	$16x$	1	*Timutua*
$x = 7$	$4x$	3	*Eurhinotropis, Hebeclada, Timutua*
	$8x$	1	*Timutua*
	$12x$	1	*Timutua*
$x = 8$	$2x$	1	*Monninopsis*
$x = 10$	$4x$	1	*Timutua*
$x = 15$	$2x$	1	*Microthrix*
	$4x$	1	*Microthrix*
$x = 17$	$2x$	3	*Monninopsis, Timutua*
	$4x$	4	*Timutua*
$x = 23$	$2x$	1	*Timutua*

SYNTHESIS OF ASTER HERVEYI

LEONARD J. UTTAL

Long suspected to be a hybrid between *Aster spectabilis* Ait. and *A. macrophyllus* L.[1], *A. Herveyi* Gray can now be reported as so in fact. The putative parents have been artificially crossed and resulting progeny compare satisfactorily with naturally occurring *A. Herveyi.* Subsequent reference to this plant will be as *A.* × *Herveyi* Gray.

A. spectabilis is a coastal plain species from Massachusetts to South Carolina[2]. *A. macrophyllus* is a species of the eastern North American upland. The two are allopatric except in a few counties of southeastern New England and eastern Long Island. Here the two ranges impinge ecologically and physiographically, and here occur the hybrid swarms of *A.* × *Herveyi.* A specimen from Plainfield, New Jersey collected in 1909, now in the New York Botanical Garden Herbarium, indicates that sympatry between the parent species existed in parts of the New York metropolitan area before its development.

A. spectabilis and *A. macrophyllus* are both present in the

[1]Fernald, M. L. 1950. Gray's Manual of Botany, 8th. Ed.: 1430.

[2]Southern limit based on information from North Carolina herbaria. (Harry E. Ahles, pers. com.)

vicinity of Sag Harbor, Suffolk County, Long Island. *A.* × *Herveyi* occurs here in colonies among which there is a central clone of robust plants surrounded by smaller clones of plants of diminishing stature. Apparently introgressive clones occur consisting of plants intermediate between the hybrid and either of the parents. These can not be assigned satisfactorily to any category involved. Marked variation in vegetative vigor is evidenced by different clones in similar sites. The hybrid swarms of Long Island are similar to those on the mainland as reported by Hervey[3].

The intermediate nature of the hybrid is most graphically manifested by the basal leaves and the similar ones of the characteristic vegetative tufts. In *A. macrophyllus,* these leaves are quite large, ovate, serrate or crenate, cordate, and long-petioled. In *A. spectabilis,* comparative leaves are much smaller, lanceolate to narrowly ovate or obovate, entire or remotely serrate, the blade tissue gradually tapering to the short petiole. In *A.* × *Herveyi,* these leaves are variously intermediate in size, broad to narrowly ovate, serrate or crenate, with the blade rounded to the petiole. The blade is sometimes subcordate or cordate, in which case, blades with rounded bases are prevalent on neighboring plants.

Characters of the *A. macrophyllus* parent seem to predominate in the hybrid: leaf serration, naked petioles, usually appressed involucral bracts. Perhaps for this reason, extremes of *A. macrophy*llus have, on occasion, been called *A. Herveyi.*

Sometimes the squarrosity of the involucral bracts of *A. spectabilis* comes through slightly in hybrids. In such cases, it tends to be accompanied by the deep purple-blue and long rays characteristic of *A. spectabilis.*

The *A. spectabilis* parent used in the artificial crossing experiment originated in Riverhead, Suffolk County, Long Island, New York. The *A. macrophyllus* parent, of the typical variety, originated from Main Top Mountain, Amherst County, Virginia. Crossings were made in my garden in Madison Heights, Virginia. The *A. spectabilis* was planted

[3]Hervey, E. W. 1916. Rhodora 18: 183-184.

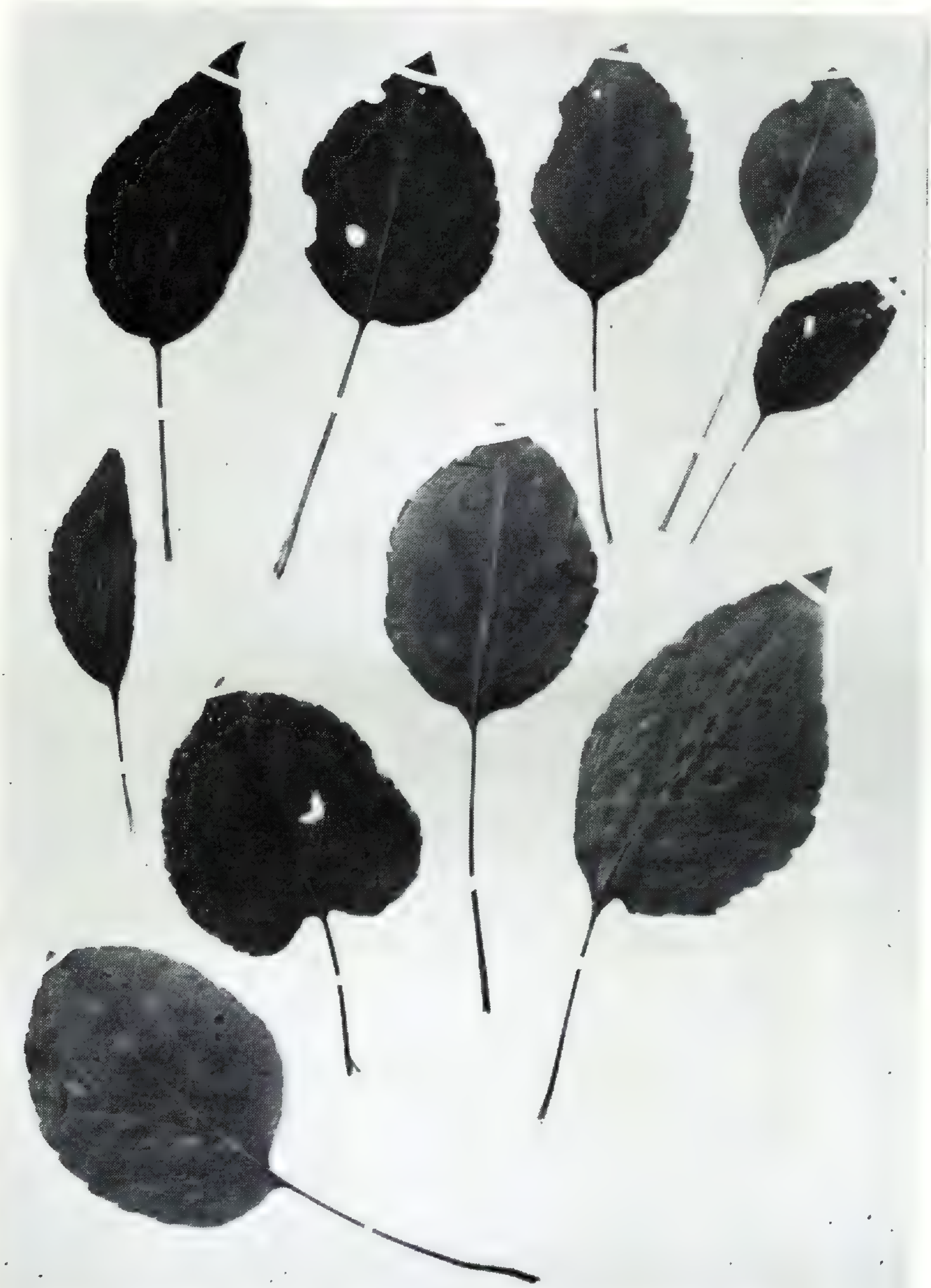

PLATE 1267. Representative leaves from the vegetative tufts of synthetic *A.* × *Herveyi*. The range of naturally occurring variation is artificially duplicated.

in the ground while the *A. macrophyllus* was kept in a pot for mobility. Both were kept in individual cheesecloth tents to prevent entomophilous contamination of heads.

Working on the presumption that both putative parents are self-incompatible (other *Aster* species tested are[4], and populations of parent species are characteristic of outbreeders), flower heads of both were pressed together to effect pollination. These heads produced abundant plump achenes. Certain heads not pollinated and left to themselves produced only shriveled achenes.

Ripe achenes were sown in flats kept outdoors over winter. Sprouting was sparse in late fall; abundant the following April. Eight F_1 plants bloomed the first fall (1961) and were made into herbarium sheets. Seven of these, with a sheet each of the parents, were sent to the Gray Herbarium for preservation. An eighth F_1 sheet was sent to the New York Botanical Garden Herbarium. Many additional F_1 plants, vegetative in 1961, are expected to bloom in 1962. Specimens of these can be supplied upon request.

The high degree of variation prevailing in progeny resulting from multiple crossings of the same parents indicates highly complicated parental genetic makeup. This is in keeping with the extensive variability of the parents, especially of *A. macrophyllus*.

Tests of F_2 seed will have to wait another season. Observations from the field indicate F_1 fertility is impaired.

For a genus with so many sympatric outbreeding species, in an era of so much disturbed habitat, *Aster* has a remarkable paucity of described hybrids. This is an area meriting closer inspection; perhaps it is the key to better understanding of certain "difficult" taxa.

To the venerable naturalist of Orient, New York, Mr. Roy Latham, for introducing me to the Long Island hybrid swarms, and for supplying me with *A. spectabilis;* to Dr. Reed C. Rollins, Director of the Gray Herbarium, for verifying my work, to Mr. Joseph Monachino, of the New

[4]Fryxell, P. A. 1957. Bot. Review 23(3): 169.

York Botanical Garden, and Dr. Harry E. Ahles, of the University of North Carolina Herbarium, for valued assistance, I express my sincere appreciation.

— MADISON HEIGHTS, VA.

THREE MISIDENTIFIED SO-CALLED CORDILLERAN SPECIES IN EASTERN NORTH AMERICA[1]

EILIF DAHL

Since the work of Fernald (1925) the cordilleran species in eastern North America have attracted considerable attention. With increasing exploration, expecially of the formerly little-known areas around Hudson Bay and the Canadian Arctic Archipelago, many species previously considered as cordilleran disjuncts have been shown to have a more or less continuous area across the continent (Raymond, 1950). Many of the remaining cordilleran disjuncts are serpentinicolous species, halophilous species or species with adaptations to long-distance dispersal (light wind-dispersed spores or seeds, hooks on the fruits, etc.). Only a very limited list of species with no adaptations to long-distance dispersal remains as cordilleran disjuncts and it will be shown below that the records of three of them are based upon misidentifications.

1. *Agrostis rossae* Vasey was reported from Newfoundland at Bonne Bay by Fernald (1933 p. 203) based on a specimen collected by K. P. Jansson. The specimen is kept in the Gray Herbarium and consists of two culms, 18 and 20 cm. high, and attached basal tufts of leaves, the leaves being about 1 mm. broad. Dead leaves from the previous year testify the plant to be perennial thus corresponding to the Rocky Mountain *A. variabilis* Rydb., the name *A. rossae* Vasey being reserved for an annual plant restricted to hot springs in Yellowstone Park, Wyoming (Chase 1950 p. 342 and 346). The panicle is narrow, almost spikelike, with

[1]Contribution from the Herbarium of the University of Colorado Museum.

spikelets near the base of the lower branches. In these characters the Newfoundland plant compares well with Rocky Mountain *A. variabilis*.

However, in some important characters the Newfoundland plant differs from *A. variabilis*. Most important is the presence of a palea a little more than half the length of the lemma, while in true *A. variabilis* the palea is minute or absent. In the Newfoundland plant the ligule on the culm leaves is 0.3-0.4 mm. long and on the sterile shoots about 0.6 mm. and rather transversely cut. In Rocky Mountain *A. variabilis* the ligule of the culm leaves is 1.3-2.0 mm. long, somewhat acute and continuing downwards as a hyaline margin of the sheath. Thus it is evident that the Newfoundland plant neither belongs to *A. variabilis* nor to *A. rossae* s. str.

In the characters of the palea and the ligule the Newfoundland plant compares well with the European *A. tenuis* Sibth. and it was found in an area where a European element in the flora is strongly pronounced. Lindroth (1957) has shown how many of these species became introduced during the early fishing trade between Europe and Newfoundland. *A. tenuis* is a highly variable species, usually with a more spreading panicle and higher culms than the Newfoundland plant, but the Newfoundland specimen comes well within the range of variation in these respects of the European *A. tenuis*.

2. *Carex filifolia* Nutt. was recorded by Delabarre (1902 p. 192) from Nachvak in Labrador, the identification being accredited to Fernald. The specimen is kept in the herbarium of Brown University, R. I. The material consists of two culms, 10 and 13 cm. high, with no leaves or rooting parts attached, and carry spikes about 1 cm. long with an upper staminate part and a lower pistillate part. The pistillate flowers are badly infected by smut; no intact perigynia are present.

Two species come in question for identification of the scanty material, the cordilleran *C. filifolia* Nutt. and the circumpolar *C. rupestris* All.; the latter is well known to

occur in Labrador. The culms are slightly higher than average for *C. rupestris* in the area, but well within the range of variation of the species. The best character separating the two species is that the perigynia are hairy in *C. filifolia* and glabrous in *C. rupestris*. The hairs on the perigynia may sometimes be seen even in smut-infected flowers of *C. filifolia;* no such hairs were observed in the Nachvak plant, but this is not entirely reliable. There are, however, other indications that the Labrador plant belongs to *C. rupestris* rather than to *C. filifolia*.

a. In *C. filifolia* the lower pistillate bracts are gibbous at base forming a broad sac, and the bracts have a very wide hyaline margin only the central part being brownish. In *C. rupestris* and the Nachvak specimen the lower pistillate bracts are not gibbous at base and are brown over most of the area.

b. In *C. rupestris* and the Nachvak specimen the upper part of the culm is sharply triangular, often with scabrosely toothed margins and also in the middle and lower part of the culm the triangular outline can be seen. In *C. filifolia* the culms are round or very obtusely triangular and rarely scabrosely toothed.

c. The smut on the specimen has been examined by Dr. D. S. O. Savile, Department of Agriculture, Ottawa, who writes: "Smut is *Cintractia caricis* (Pers.) Magn. affin. v. *caricis* closely matching many specimens on *C. rupestris* including Ungava peninsula. Smut on *C. filifolia* is quite distinct."

Thus, it is almost certain that the collection from Nachvak in Labrador belongs to *C. rupestris* and can on no account, with confidence, be assigned to *C. filifolia*.

3. *Polygonum bistortoides* Pursh has been recorded from southwestern Newfoundland by Fernald (1950 p. 580). The specimen was collected by A. S. Pease and M. S. Edgerton on July 10th, 1939 in rills and open meadows in the Cape Anguille Mts., Millville, and is kept in the Gray Herbarium. It consists of four basal leaves with no fruiting or flowering stems and does not look very similar to material of

P. bistortoides collected in the Rocky Mountains. The leaves are long, 16-22 cm. with long stipes, 12-22 cm. Such long leaves can sometimes be found also in the Rocky Mountains. A comparison of leaves of the same length from the Rocky Mountains with the collection from Newfoundland gives a number of significant differences which can be summarized as follows:

Polygonum bistortoides Rocky Mountains	**"Polygonum bistortoides"** Newfoundland
Leaves (2)3-4(4.5) cm. broad.	Leaves 2-3 cm. broad.
Central nerve 0.5-2(3) mm. broad, firm.	Central nerve 2-3.5 mm. broad, showing a number of separate vascular bundles.
First order sidenerves 0.4-1.4 cm. apart.	First order sidenerves 1.5-2 cm. apart.
Epidermis even, hairy or pruinose below.	Epidermis scabrosely papillose or wrinkled, neither hairy nor pruinose.
Microscopic circular glands on the nerves.	Glands lacking.
Marginal leaf-cells longitudinally oriented, brown, with narrow lumina, margin smooth, curving downwards.	Marginal leaf-cells isodiametric, hyaline, margin finely dented or eroded, plane.

Thus it is evident that the Newfoundland collection does not belong to *P. bistortoides*. In all characters outlined above it compares better with a species of *Rumex*, particularly of the group *Axillares*. Especially the characters of the central nerve and the leaf margin serve to discriminate between the two genera. It is not easy to assign the material to any particular species of *Rumex* although *Rumex pallidus* might be a good guess.

I am indebted to the curator of the Gray Herbarium and to Professor Church, Brown University, R. I. for loan of specimens, to Dr. D. S. O. Savile, Ottawa for identification of a smut and to Dr. W. A. Weber, University of Colorado for placing herbarium facilities at my disposal and for stimulating discussions. — AGRICULTURAL COLLEGE OF NORWAY, VOLLEBEKK, NORWAY.

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ADDITIONS TO THE BRYOPHYTE FLORA OF KEWEENAW COUNTY, MICHIGAN

F. J. Hermann[1]

The Keweenaw Peninsula, on Lake Superior in northernmost Michigan, became botanically renowned with the publication in 1935 of Fernald's paper, *Critical Plants of the Upper Great Lakes Region of Ontario and Michigan* (2). In this paper Professor Fernald discussed at length an impressive assemblage of species among the vascular plants, known principally from the Rocky Mountains and the Pacific coast but occurring also in isolated colonies on the Keweenaw Peninsula and a few other restricted areas, possibly unglaciated during the Pleistocene, far east of their principal range.

In 1937 and 1938 Dr. W. C. Steere published noteworthy papers on the bryophytes of the Keweenaw Peninsula (10, 11) in which he pointed out that many of the mosses and hepatics occurring on the Peninsula paralleled the disjunct distribution of the Cordilleran, Pacific coast and arctic vascular plants enumerated by Fernald. Western and arctic

[1]Forest Service Herbarium, Division of Range, Wildlife Habitat and Recreation Research, U. S. Department of Agriculture, Washington, D. C.

elements in the flora of Isle Royale (which is also part of Keweenaw County) have likewise been known as a result of Ruthven's ecological survey (7) and of a fairly recent survey of the bryophytes of the island (13), in which account was taken of earlier reports by Holt (6) and Cooper (1).

That the bryophyte flora of Keweenaw is still incompletely known, however, was pointed out by Steere and was attested by the results of a few days' collecting by the writer around Copper Harbor, on the peninsula, and Rock Harbor, on the island, during August 1960. Because the bryophytes of Michigan as a whole (12), and of the Isle Royale and the Keweenaw Peninsula in particular, are comparatively well-documented it seems worth while to record here the few additions (which include three genera new to the State) to the known flora that turned up in 1960.

The writer is grateful to Howard Crum and Margaret Fulford for help in the identification of critical species, and to A. LeRoy Andrews he is indebted for determination of the Sphagnum and Bryum. Robert R. Ireland kindly gave permission to include the record of his collection of *Trichodon cylindricus* made in 1961.

Species new to the flora of Michigan, based on Steere, 1947 (12), are indicated in the following list with an asterisk. All of the species listed, with the exception of *Andreaea rupestris*, are new to either the Keweenaw Peninsula or Isle Royale according to the most recent reports (12, 13). Specimens have been deposited in the U. S. National Herbarium, Washington, D. C. and duplicates in the herbarium of either the University of Michigan, Ann Arbor or Michigan State University, East Lansing, and the National Herbarium of Canada.

KEWEENAW PENINSULA

Lophozia quadriloba (Lindl.) Evans. On conglomerate shore of Lake Superior at edge of woods, Copper Harbor, *16354*. Although this species is not included in the most recent list (12) of Michigan bryophytes, it has been subsequently reported from Copper Harbor by Schuster (8) in his account of Minnesota hepatics.

Andreaea rupestris Hedw. On granitic outcrop, Mt. Bohemia, just west of Lac La Belle, *16218*. This moss is not new to either the Keweenaw Peninsula or Isle Royale but additional records are noted here because of its rarity in the State. As pointed out by Steere (10) it has previously been known in Michigan from only a single locality on Isle Royale and from one each in Keweenaw and Marquette Counties.

Encalypta procera Bruch. Abundant on conglomerate bluff at edge of woods along Mandan Road (US 41), 1 mile south of Copper Harbor, *16236*. (Determination verified by Seville Flowers). The geographical distribution of this species is given by Flowers (3) as "Alaska to Montana, Idaho and Washington. Common in British Columbia. Also in Ontario, Greenland, Northern Europe and Asia." It was reported from Isle Royale by Cooper (1), however, in 1913.

Heterocladium squarrulosum (Voit) Lindb. Base of gneiss outcrop near shore of Lake Superior, Copper Harbor, *16151;* moist conglomerate slope, gorge of Manganese River, ½ mile south of Copper Harbor, *16163*. Apparently the only previous Michigan record for this species is from the Porcupine Mountains, Ontonagon County.

***Oreoweisia serrulata** (Funck) De Not. On moss-covered crest of conglomerate shore of Lake Superior, Devil's Washtub, 1½ miles west of Copper Harbor, *16133;* crevice in conglomerate shore of Lake Superior, Fort Wilkins, Copper Harbor, *16225*. Also occurring on Isle Royale as noted below. Although Grout (5) refers to this moss as being a rare plant in North America (and a calciphile), unlike most of the other Keweenaw novelties it is not predominantly western or arctic in its distribution but is known also from eastern North America and in the mountains as far south as Tennessee and Kentucky.

Orthotrichum sordidum Lesq. & James. On trunk of sugar maple in woods near Lake Manganese, 1 mile south of Copper Harbor, *16101;* on trunk of ash, Silver Creek, 4½ miles east of Eagle Harbor, *16138*.

***Trichodon cylindricus** (Hedw.) Schimp. (*Ditrichum cylindricum* (Hedw.) Grout). On soil along road up Mt. Bohemia, alt. 867 ft., just west of Lac La Belle, *R. R. Ireland, Jr. 5364*, Aug. 21, 1961 (US). This is another farwestern species which is evidently a glacial relic in Michigan. Grout (5) gives its range as "western North America, Yukon to Montana, Nevada and Washington."

***Trichostomum tenuirostre** (Hook. & Tayl.) Lindb. (*T. cylindricum* (Bruch) C. Muell.) Moist crevices in conglomerate shore of Lake Superior, Fort Wilkins, Copper Harbor, *16118*. An earlier, but evidently unreported collection, from Keweenaw County by W. C. Steere and A. J. Sharp was recently noted in the University of Michigan Herbarium by Mrs. Jennie Dieterle and called to the writer's attention. It was collected on Mt. Bohemia, September 1, 1937. Like *Oreoweisia* this is a species of widespread distribution, occurring as far south as the mountains of North Carolina and Arizona.

ISLE ROYALE

Cephaloziella striatula (Jens.) Douin. With *Lophozia ventricosa* on vertical face of saturated tussock of *Scirpus caespitosus* in rock pool, Scoville Point, *16325½*. Not recorded from Michigan in Steere's list (12), and ascribed only to Greenland, Alaska, British Columbia and Europe by Frye and Clark (4), but Schuster (8) reports the species (as *C. subdentata* Warnst.) from Minnesota, Michigan (Cheboygan County), Maine, New Hampshire and New York.

Scapania paludicola Loeske & K. Muell. In bed of *Empetrum* at edge of rock pool, Scoville Point, *16328½*.

Amblystegium serpens (Hedw.) BSG. On conglomerate near shore of Rock Harbor, *16261*.

Andreaea rupestris Hedw. On vertical face of basalt boulder along trail to Scoville Point, *16325;* on basalt boulder along trail to Hidden Lake, *16333*. Previously known on Isle Royale only from Passage Island (13).

Anomodon attenuatus (Hedw.) Hüben. In shallow cave below Monument Rock, *16345½*. It seems remarkable that no species of this usually very common genus has previously been reported from the island.

Bryum cuspidatum (BSG.) Schimp. Crevice in trap rock shore of Rock Harbor, *16281*. A questioned report of *B. affine* (Bruch.) Lindb. in Thorpe and Povah's list (13) might be referable to *B. cuspidatum*.

Calliergon giganteum (Schimp.) Kindb. On *Thuja* log near Hidden Lake, *16335*.

Cynodontium schistii (Wahl.) Lindb. On vertical face of boulder in shade, Monument Rock, *16349*.

Dichodontium pellucidum (Hedw.) Schimp. Crevice in trap rock shore of Rock Harbor, *16275*.

Grimmia alpicola Hedw. On trap rock shore of Rock Harbor, *16262* and *16282*. Only var. *rivularis* Brid. has been previously recorded from Isle Royale.

Grimmia apocarpa Hedw. var. **stricta** (Turn.) Mitt. Extensive mat on trap rock shore of Rock Harbor, *16260*. Only the typical form of the species has been reported from Isle Royale, although *G. ambigua* and *G. conferta*, also reported, are now commonly treated as additional varieties of the polymorphic *G. apocarpa*.

Mnium punctatum L. var. **elatum** Schimp. Crevice in conglomerate shore of Rock Harbor, *16273*. The variety has not been previously reported from the island.

Oreoweisia serrulata (Funck) De Not. On trap rock shore of Rock Harbor, *16280*.

Orthotrichum obtusifolium Brid. On trunk of aspen, upper shore of Rock Harbor, *16274* and *16284;* on trunk of mountain ash, trail to Scoville Point, *16324*.

Orthotrichum sordidum Lesq. & James. On trunk of aspen, shore of Rock Harbor, *16273½*.

Pylaisia selwynii Kindb. On trunk of aspen, trail to Scoville Point, *16317*.

Rhytidium rugosum (Hedw.) Kindb. In bed of *Empetrum* at edge of rock pool, Scoville Point, *16331*.

Sphagnum dusenii C. Jens. In *Chamaedaphne* bog, Raspberry Island, *16300*.

Tortella fragilis (Drumm.) Limpr.[2] Crevices in trap rock shore of Rock Harbor, Scoville Point, *16315*.

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[2]A collection of this species from Alger County (pockets in dry sandstone ledge, Pictured Rocks, 9 miles northeast of Munising, *16091½*) evidently represents the first recorded from that county.

CONTRIBUTION TO THE FUNGUS FLORA OF NORTHEASTERN NORTH AMERICA. II[1]

HOWARD E. BIGELOW AND MARGARET E. BARR[2]

Field work in Massachusetts during 1960 and 1961, and studies of specimens collected in previous years throughout the northeast, have revealed some agarics and pyrenomycetes which seem worthy of description. The fruiting of several other fungi is reported as well in order to extend knowledge of their distribution. Two new combinations are proposed: *Clitocybe morgani* (Peck) Bigelow and *Phaeostoma sphaerophila* (Peck) Barr.

We wish to express our appreciation to Stanley J. Smith, Senior Curator of Botany, New York State Herbarium, and to Dr. Clark Rogerson, Curator of Fungi, New York Botanical Garden, for the opportunity of studying the type material of several of the species discussed. Dr. Alexander H. Smith, Director, University of Michigan Herbarium and Dr. Kenneth A. Harrison, Research Station, Kentville, Nova Scotia have helped in loan of specimens. We gratefully acknowledge the financial support of the Faculty Research Council, University of Massachusetts. Field work in Massachusetts during 1958, 1959, and 1960 would not have been possible without the assistance of the Council. Our research in the fall of 1961 has been supported by National Science Foundation Grant G 19534.

The colors cited in the descriptions of agarics are from Ridgway, R. 1912. Color standards and color nomenclature. Washington, D. C.

BASIDIOMYCETES

Amanita parcivolvata (Peck) Gilbert, in Bresadola, Icon. Myc. 27, suppl. 1: 226. 1941.

Amanitopsis parcivolvata Peck, Bull. Torrey Club 27: 610. 1900.

Pileus 5-8.5 cm. broad, convex to plane, margin striate, disc shallowly depressed in age, surface with yellow ("maize yellow", "buff yellow") coating, powdery or somewhat floccose, glabrescent near disc,

[1]I. Rhodora 62: 186-198. 1960. Contribution from the Department of Botany, University of Massachusetts, Amherst.

[2]Mrs. Howard E. Bigelow.

margin appendiculate with yellow-floccose patches at first, soon appressed, ground color orange-yellow ("light orange yellow") or darker; flesh thin, firm, concolorous with pileus or paler, odor none, taste not known.

Lamellae free, distant from stipe, close, moderately broad (up to 1 cm.), light yellow ("massicot yellow", "straw yellow"), edges dentate to crenate from particles of partial veil.

Stipe 8-15 cm. long, 5-10 mm. in diameter at apex, 1-2.5 cm. at base, base clavate to subbulbous, fragments of universal veil forming orange-yellow floccose patches on base of stipe, whitish beneath, apex and median portion of stipe concolorous with lamellae, fibrillose or furfuraceous from remains of partial veil, yellow, powdery to flocculent, central, stuffed or hollow.

Spores 10-13 x 6-8 μ, elliptical, smooth, not amyloid, white in mass; basidia 32-46 x 8.5-13 μ, 4-spored; cystidia: cheilocystidia and pleurocystidia present but scattered, basidioid to saccate, 15-21 μ in diameter, smooth; pileus tissue: surface often with cells from veil, broadly fusoid to cylindrical or saccate, 7.5-50 μ in diameter, walls smooth or slightly roughened, thin or slightly thickened, cuticle thin, hyphae cylindrical, 3-5 μ in diameter, trama thin, hyphae cylindrical to inflated, 1.5-11 μ in diameter, clamp connections present, scattered laticiferous hyphae present; gill trama bilateral, hyphae cylindrical to inflated, 5.5-15.5 μ in diameter.

Solitary, on soil or humus in open hardwoods of beech, birch, and maple.

Material examined: *Bigelow 9232*, D.A.R. State Forest, Goshen, **Massachusetts**, Sept. 1, 1960; *9778*, Conway, Sept. 5, 1961; *9956*, Conway, Oct. 9, 1961.

A. parcivolvata appears to be typical of a more southern agaric flora, but does appear in the northern states in small quantity upon occasion. Hesler (1960) has published a photograph of the species.

Pilát (1954) lists *A. parcivolvata* as a synonym of *Amanita muscaria*. The two species are quite distinct by the nature of the veils. In *A. parcivolvata* both veils are powdery and very fragile, never forming warts or a persistent, membranous annulus as in *A. muscaria*.

Cantharellus minor Peck, N. Y. State Cab. Rep. 23: 122. 1872. Plate 1268.

Pileus 5-30 mm. broad, convex at first, becoming plane with a narrowly decurved margin and the disc slightly depressed, finally infundibuliform with the margin arched and undulate, even, glabrous, yellow-orange to orange when moist ("orange"), fading to pale orange-buff or pale orange; flesh concolorous with pileus, thin, no odor or taste when fresh, at times developing fragrant odor like *Cantharellus cibarius* after drying.

Lamellae decurrent (unevenly), distant, very narrow, forked, not

intervenose, edges even, somewhat thickeed, straight, concolorous with the moist pileus ("orange").

Stipe 1.5-2.5(-5) cm. long, 3-7(-9) mm. thick at the apex, base attenuated, central, hollow, glabrous, compressed and furrowed at

PLATE 1268. *Cantharellus minor* Peck × 1.

times, often curved and flexuous, concolorous with moist pileus or paler ("deep chrome"), not fading, base slightly more yellowish where embedded in humus.

Spores 6-11.5 x 4-6 μ, usually broadly elliptical or elliptical to oblong, at times bent on apicular side, smooth, not amyloid, light yellowish-orange in mass; basidia (34-)39-65 x 4.5-8.5 μ, 4-spored; cystidia not differentiated; pileus tissue: light yellow-orange or yellow in KOH, pigment dilute in cell contents, cuticle thin and indistinct, hyphae mostly cylindrical, 2.5-5.5 μ in diameter, tramal hyphae cylindrical to inflated, 3-12(-16) μ in diameter, clamp connections present; gill trama interwoven, hyphae mostly cylindrical, 1.5-4.5 μ in diameter.

Scattered to gregarious, on humus, in open hardwoods, particularly of beech and maple. July to August.

Material examined: *Bigelow 3755*, Madawaska, **Maine**, Aug. 2, 1956; *7015*, Amherst, **Massachusetts**, July 23, 1958; *7080*, Amherst, July 24, 1958; *7229*, Amherst, July 30, 1958; *7549*, Mt. Tom State Reservation, Holyoke, Aug. 19, 1958; *8888*, Williamsburg, July 14, 1960; *9052*, Conway State Forest, Conway, Aug. 9, 1960; *9524*, Amherst, July 14, 1961; *9542*, Amherst, July 18, 1961; *9587*, Conway State Forest, Conway, July 23, 1961; *9622*, Pittsfield State Forest, Pittsfield, July 26,

1961; *9632*, Conway State Forest, Conway, July 27, 1961; *9661*, New Salem, Aug. 2, 1961; *C. H. Peck*, Greenbush, **New York**, July (type of *C. minor*).

The position of this fungus is difficult to determine. It resembles *C. cinnabarinus* Schw. in stature, but *C. cibarius* Fr. in color. On the other hand, there is a waxy quality which first led me to try and determine it in *Hygrophorus*. Possibly, *C. minor* occupies an intermediate position between the two genera, but certainly the colored spore deposit indicates a closer relationship to *Cantharellus*.

Of uncertain relationship is *Cantharellus Friesii* Quélet which occurs in Europe. According to the literature this species seems very close to *C. minor*.

Clitocybe morgani (Peck) Bigelow, *comb. nov.*
Cantharellus morgani Peck, Bot. Gaz. 7: 43. 1882.
Cantharellus olidus Quélet, Ench. Fung. p. 138. 1886.
Cantharellus rosellus Peck, N. Y. State Mus. Rep. 42: 24. 1889.
Clitocybe olida (Quél.) Konrad, Bull. Soc. Myc. Fr. 45: 60. 1929.
Hygrophoropsis olida (Quél.) Métrod, Rev. de Myc. 14, Suppl., p. 15. 1949.

Material examined: *Bigelow 3432*, near Guerette, Aroostook Co., **Maine**, July 23, 1956; *3569*, July 26, 1956; *3594*, *3626*, July 29, 1956; *3704*, Aug. 1, 1956; *4442*, Aug. 28, 1956; *J. Dearness*, *2696*, Kilworth woods, near Toronto, **Ontario**, Sept. 14, 1928; *K. Harrison 191*, Heighbury, **Nova Scotia**, Oct. 10, 1932; *2466*, Glenmont, Sept. 28, 1953;*3984*, Waternish, Guysborough Co., Sept. 5, 1957; *3985*, Cape Split, Kings Co., Sept. 1, 1958; *4630*, Sept. 1954; *4631*, Aspen, Antigonish Co., Sept. 2, 1956; *4641*, Glenmont, Kings Co., Oct. 11, 1952; *4642*, Casey's Corner, Kings Co., Oct. 12, 1952; *4643*, Ayleford Lake, Kings Co., Oct. 10, 1952; *A. P. Morgan*, **Vermont** (type of *Cantharellus morgani*); *C. H. Peck*, North Elba, **New York**, September (type of *Cantharellus rosellus*).

Formerly, this agaric was treated by most investigators under the name *Clitocybe olida*. A complete description based on specimens from Oregon and Washington has been published by Smith (1944). However, recent study of type material in the Peck Herbarium at Albany reveals that *Cantharellus morgani* is identical, necessitating a new combination in *Clitocybe*. The dried carpophores of the type agree in all observable details with specimens determined as *Clitocybe olida* from several localities in North America. Peck's description also compares favorably in most respects with that of *Cantharellus olidus* Quélet. Peck did not mention any odor for *C. morgani*, but this discrepancy does not seem serious in view of the collaborating evidence of other field characters and microscopic features.

Clitocybe morgani appears confined to a coniferous habitat, particularly spruce and fir in the northeastern region. The distribution of

the species in North America is broader than previously known though fruiting seems abundant only in certain restricted localities. Besides the collections cited above I have had also the opportunity to examine material deposited at the University of Michigan Herbarium from Colorado, Idaho, Michigan, Oregon, and Washington.

PLATE 1269. *Laccaria trullisata* (Ellis) Peck. × 1/2.

Laccaria trullisata (Ellis) Peck, N. Y. State Mus. Bull. 157: 90. 1912. Plate 1269.

Agaricus trullisatus Ellis, Bull. Torrey Club 5: 45. 1874.

Clitocybe trullisata (Ellis) Saccardo, Syll. Fung. 5: 195. 1887.

Pileus 2.5-6 cm. broad, convex to plane with an incurved margin, even, disc depressed at times, surface dry, matted-fibrillose to scaly, areolate and cracked at times, color often irregular, streaked and mottled, with various shades of brown and buff ("vinaceous buff", "avellaneous", "fawn", "army brown", "wood brown", "russet", "mikado brown", "tawny", "cinnamon brown", "cinnamon"); flesh rather thick, soft, concolorous with pileus or lamellae, no odor or taste.

Lamellae adnate to decurrent (unevenly), subdistant to distant, broad (up to 12 mm.), not forked or intervenose, color purplish when young ("vinaceous purple", "slate purple", "deep slate purple", "dark lavender"), rufous in age (nearest "army brown", "sorghum brown"), pruinose at times, edges even, thick, brittle.

Stipe 2-10 cm. long, 5-20 mm. thick at apex, tapering upward from a long clavate or clavate-bulbous base, deeply embedded in sand, often

compressed, solid-stuffed, central, surface fibrillose-streaked above, reddish brown ("tawny", "russet", "mars brown", "cinnamon brown"), base purplish and concolorous with young lamellae, often with purplish mycelium.

Spores 11.5-19 x 6-7 μ, elliptical to oblong, finely punctate under oil immersion, not amyloid, white in deposit; basidia 42.5-60 x 10-13 μ, mostly 4-spored, occasionally 2-spored, sterigmata 4.5-7.5 μ long; cheilocystidia present in some sections, basidioid to broadly cylindrical or broadly fusoid, 14-19 μ broad, 31-46 μ long, protruding beyond hymenium 15-30 μ; pileus tissue: cuticle brownish in KOH, pigment dilute in cell contents or in slightly thickened walls, cuticular hyphae interwoven, numerous end cells protruding beyond surface, cylindrical or subclavate, hyphae mostly cylindrical, 5.5-11.5 μ in diameter, trama hyaline, hyphae 7.5-14.5 μ in diameter, cylindrical to inflated, clamp connections large and abundant; gill trama regular to subparallel, hyphae mostly cylindrical, 4-8 μ in diameter.

Solitary, scattered, or subcespitose. In sand, near open white pine. September to October.

Material examined: *Bigelow 6314*, North Sunderland, **Massachusetts**, Sept. 24, 1957; *7837*, Sept. 25, 1958; *9342*, Sept. 22, 1960; *9792*, Sept. 6, 1961; *9922*, Northfield, Oct. 7, 1961.

Abundant fruitings of *L. trullisata* are common on certain dunes along the Connecticut River valley. While associated with white pine in this region, this agaric occurs under jack pine on the Lake Superior shore of northern Michigan.

The spores of this species are reported as smooth in the literature. However, under the oil immersion lens there are very fine punctations at least on some of the spores. These markings are difficult to observe and it was not possible to tell if they were protrusions or pits. The presence of some ornamentation lends support for maintaining this species in *Laccaria*.

Lentinus haematopus Berkeley, Grev. 1: 33. 1872.

Material examined: *Bigelow 3401*, Guerette, Aroostook Co., **Maine**, July 20, 1956; *4060*, Aug. 16, 1956.

This species, unusual because of the curious red coating on the stipe, has been reported from a variety of locations in the northeast. It seems widely distributed but fruits seldom and then only in small numbers. I know of collections from Vermont, New Hampshire, Ontario, New York, Michigan, and Saskatchewan, as well as the new records cited above. Solitary specimens were found on birch or maple logs in both Maine collections. A complete description and photograph are found in Overholts (1934).

Mycena urania (Fr.) Gillet, Champ. Fr. 1: 279. 1878.

Agaricus uranius Fries, Syst. Myc. 1: 144. 1821.

Material examined: *Bigelow 5256* and *5257*, Mt. Albert, Gaspé Parc, **Quebec**, July 7, 1957.

Numerous carpophores were found on wet moss near a stream by the Park Headquarters at Mt. Albert, Quebec. This species is noted as rare by Smith (1947), in his monograph of *Mycena*. Previous records from North America are from Michigan, North Carolina, and Tennessee.

Tricholoma davisiae Peck, Bull. Torrey Club 27: 611. 1900.

Melanoleuca davisiae (Peck) Murrill, N. Am. Fl. 10: 14. 1914.

Pileus 10-13 cm. broad, obtuse conic at first, becoming plane with a slight broad umbo, margin narrowly incurved, even, sinuate or lobed at times, somewhat elevated and recurved in places when old, surface dry, radiate-fibrillose on the disc, fibrillose-scaly at the margin, ground color dull yellow, fibrils smoky gray; flesh whitish, moderately thick on the disc, thin at the margin, odor and taste farinaceous.

Lamellae sinuate, close, broad, yellow but bruising reddish, edges uneven, undulate.

Stipe 10-11 cm. long, 2-4 cm. thick at apex, base abruptly tapered, central, solid-stuffed, surface silky fibrillose, white but bruising reddish.

Spores 6-7.5 x 4.5-5.5 μ, subglobose to elliptical, smooth, not amyloid, white in mass; basidia 21.5-30 x 5.5-7.5 μ, 1-, 2-, and 4-spored; cheilocystidia present, clustered or scattered, obtuse or clavate, sometimes pedicellate, smooth, hyaline or with yellowish contents in KOH, 23-36 μ long, 6-15 μ in largest diameter, two-celled at times, pleurocystidia also present at times but rare, size and shape same as cheilocystidia; pileus tissue: cuticle pale yellowish in KOH, pigment apparently in slightly thickened walls or as very fine encrustation, hyphae cylindrical to somewhat inflated, 4.5-18 μ in diameter, cells short, 11.5-84.5 μ long, trama hyaline, hyphae cylindrical or somewhat inflated, 4-13 μ in diameter, smooth, walls thin, cells short to long, clamp connections absent; gill trama regular to subparallel, broad, hyphae cylindrical to inflated, 3-12 μ in diameter.

Gregarious, on humus at roadside in mixed woods. September to November.

Material examined: *Bigelow 9288*, Conway State Forest, Conway, **Massachusetts**, Sept. 18, 1960; *9381*, Sept. 29, 1960; *H. C. Davis*, Falmouth, **Maine**, November, 1899 (type of *Tricholoma davisiae*).

As far as I have been able to determine, this is the first record of fruiting for this species since the original description based on specimens found in Falmouth, Maine. The Massachusetts collections cited above were found growing along a roadside in a mixed woods of beech, birch, maple, pine, and hemlock.

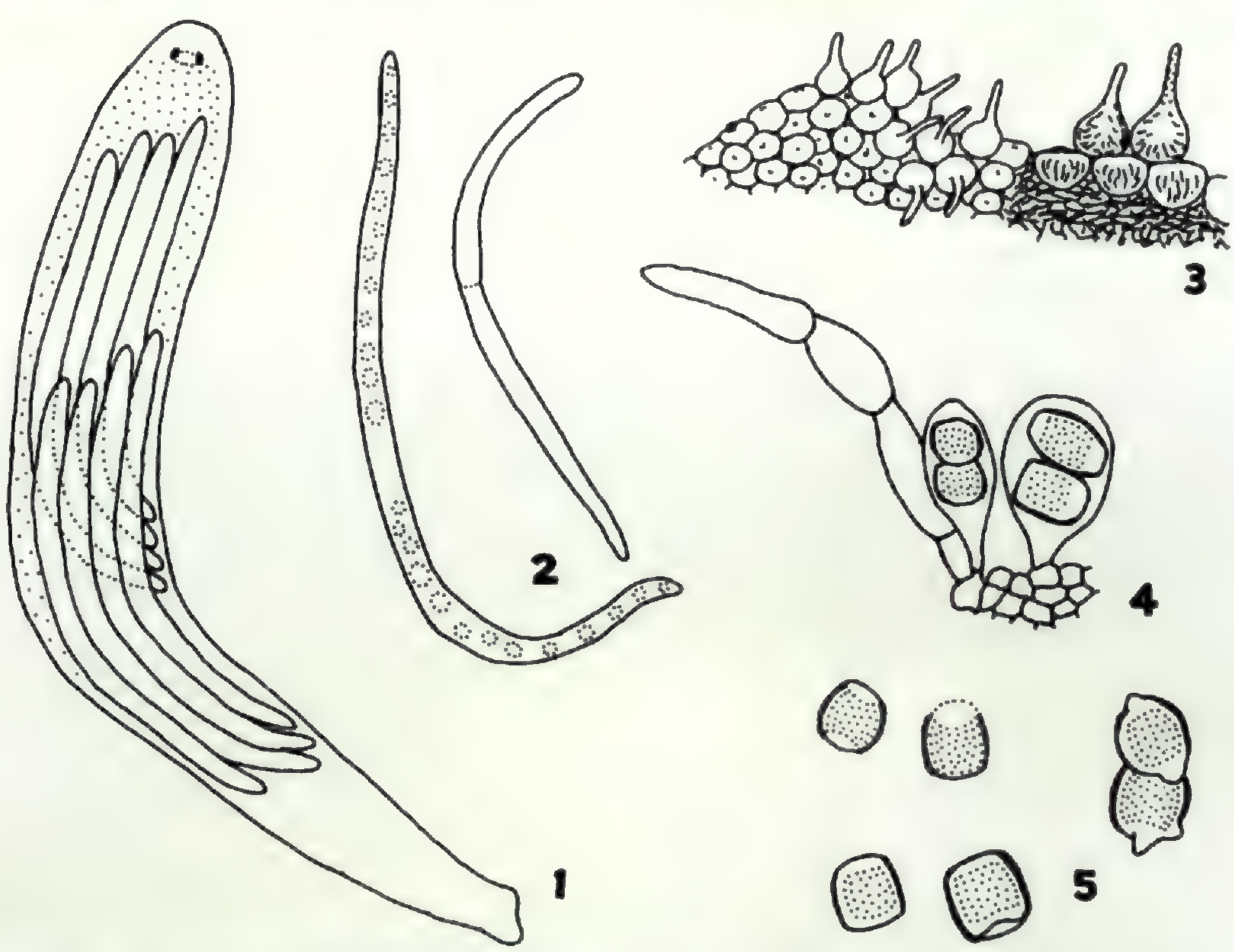
T. davisiae is a striking species by virtue of the colors and size of carpophore as well as the microscopic characteristics. Particularly noteworthy is the cuticular structure of the pileus and the presence of cystidia on the lamellae. The cuticle, composed of very short cells, cannot be considered "hymeniform", for the cells are recumbent and apparently form from the fibrils on the cap surface. The cystidia

usually do not protrude beyond the basidia to any great extent, but they are conspicuous by their diameter and frequent two-celled nature. One-spored basidia were observed upon occasion but they did not attain the size of the cystidia. Cheilocystidia were not difficult to locate in the Massachusetts collections, but pleurocystidia seemed less frequent than in the type collection.

Xeromphalina kauffmanii A. H. Smith, Pap. Mich. Acad. I. 38: 81. 1953.

Material examined: *Bigelow 9605*, Pittsfield State Forest, **Massachusetts**, July 27, 1961.

The type collection and additional material of this species were found on oak stumps during late spring and early summer in Michigan according to Smith (1953). The Massachusetts collection is small in number of carpophores and was found on a birch stump.



Figs. 1, 2. *Ophiodothella vaccinii* Boyd: 1, ascus, 2, two spores, on the right showing a pseudoseptum in Melzer's reagent. Figs. 3-5. *Phaeostoma sphaerophila* (Peck) Barr, *comb. nov.*: 3, habit of fungus over black knot, 4, asci and hypha from centrum, 5, ascospores, those on the right showing scattered protrusions. Figs. 1, 2, 4, 5, × 1500; fig. 3, × 15.

ASCOMYCETES

Ophiodothella vaccinii Boyd, Mycologia 26: 465. 1934. Figures 1, 2.

Material examined: *Barr 2855*, Mt. Toby, Leverett, **Massachusetts**, Oct. 20, 1960; *W. H. Davis 2884*, Leverett, Oct. 20, 1922 (as *Rhytisma*

vaccinii Schw.); *E. S. Boyd*, Athens, **Georgia**, April, 1933 (cotype of *Ophiodothella vaccinii*).

This fungus appears to be predominantly southern in distribution. Most of the herbarium specimens examined were from Georgia, Mississippi, and South Carolina, on *Vaccinium arboreum*. The Davis specimen cited above was on *V. stamineum*, and although immature was identical with my collection on *V. corymbosum*.

My collection was immature when gathered but after four days in moist chamber produced asci and spores. It agrees in most respects with Boyd's (1934) detailed description and with authentic material of the species. Smaller leaf spots, lack of a conidial stage, and only partial development of a second beak in the Massachusetts material were the differences noted. Boyd's description should be corrected in one respect. There is no amyloid reaction (I+) in the ascus, as she stated, but the inner perithecial wall turns blue in Melzer's reagent.

Boyd suggested that *Ophiodothella* should be placed in the Clypeosphaeriaceae, because of the development of a clypeus. However, the sphaeriaceous structure, immersed perithecia, and stroma of superficial blackened clypeus and light-colored hyphae within the substrate, all agree with the Polystigmataceae of modern authors. *O. vaccinii* and the other species of *Ophiodothella* which I have examined are quite closely related to *Polystigma*, *Phyllachora*, and *Diachora* of the Polystigmataceae, differing chiefly in the filiform or cylindrical spores. *O. vaccinii* appears to be particularly closely related to *Diachora onobrychidis* (Fr.) J. Mueller, the type of that genus (Arx and Mueller, 1954). Both fungi have immersed perithecia, blackened crusts in epidermal layers, hymenium in an equatorial band at the sides, and inner perithecial wall amyloid in Melzer's reagent. *Diachora* apparently has only a single beak, and the spores are ellipsoid and one-celled. *O. vaccinii* differs from the other species of *Ophiodothella* in the equatorial arrangement of asci and the frequent occurrence of two beaks on the perithecium.

Phaeostoma sphaerophila (Peck) Barr, *comb. nov.* Figures 3-5.

Periconia sphaerophila Peck, N. Y. State Mus. Rep. 34: 50. 1881.

Sporocybe sphaerophila (Peck) Saccardo, Syll. Fung. 4: 609. 1886.

Perithecia 200-400 μ in diameter, globose, with beaks 200-300 μ long (up to 1 mm. at times), 80-100 μ in diameter near base, tapering to 50-60 μ at truncate apex, thickly grouped in patches over surface of ascostromata of *Apiosporina morbosa*, superficial on a thin basal stroma of compacted brown hyphae; perithecial wall 27-40 μ wide at sides, 55-75 μ wide at base, composed of numerous layers of slightly compressed, polygonal brown cells, inner wall tissue of hyaline to yellowish layers of compressed cells, 10-15 μ wide, wall of beak of blackish-brown, parallel rows of elongate cells, canal periphysate, wall roughened externally by protruding hyphae and discharged spores.

Asci 11-16.5 x 6.5-10 μ, ovoid, with a delicate stalk of variable length, wall single, thin, deliquescent, 2-spored, numerous, arising from interior of centrum wall, interspersed with short, broad, septate hyphae.

Spores 6-10 x 4.5-6.5(-7.5) μ, oblong to doliform in side view, ovate in end view, hyaline becoming light brown, pigment concentrated in a broad band across the middle of cell, leaving ends hyaline, one-celled, wall double, thick and brown at sides, hyaline over ends, at times, especially when mounted in Melzer's reagent, bearing scattered low hyaline protrusions over surface, usually remaining in pairs after deliquescence of ascus wall.

Hyperparasitic on ascostromata of *Apiosporina morbosa* (Schw.) Arx, on various species of *Prunus*.

Material examined: *Barr 2099*, Lake Munroe, Mt. Tremblant Park, **Quebec**, July 24, 1957; *2164*, July 29, 1957; *2839*, Conway State Forest, Conway, **Massachusetts**, Sept. 18, 1960; *C. H. Peck*, Edmond's Pond, Adirondack Mts., **New York**, July, 1880 (type of *Periconia sphaerophila*).

I first became aware of the ascomycetous nature of this fungus on studying the Quebec and Massachusetts specimens. Type material of *Periconia sphaerophila* is likewise an ascomycete with well-developed perithecia and delicate, deliquescent asci, agreeing in all respects with my collections. Additional records of the species were obtained from herbarium collections of *Apiosporina morbosa* at the Universities of Massachusetts and Michigan. These are: *W. G. Solheim 622*, Mycoflora Saximontanensis Exsiccata, Williams Canyon, Manitou Springs, Colorado, Dec. 22, 1949; *V. M. Spaulding*, Ann Arbor, Michigan, 1879; *E. Bartholomew 2335*, Fungi Columbiani, Long Pine, Nebraska, Oct. 12, 1906; *A. H. Povah*, Dells, Wisconsin, May, 1929. From the scattered distribution records thus obtained, it seems that *Phaeostoma sphaerophila* must be of frequent occurrence on the common black knot disease of plums. The species is readily recognized in the field by the rough, spiny surface caused by the long protruding beaks over the otherwise smooth knot.

The superficial perithecia with carbonaceous dark wall, long beak, thin-walled asci, and one-celled brownish spores are characteristic of the genus *Phaeostoma* Arx and Mueller (1954). Doguet (1955) discussed the fungus, as *Melanospora sphaerophila* Sacc. He noted that this name was given on the label of Reliquiae Farlowianae 56, but he could not discover if Saccardo had actually published the combination. I was also unable to find valid publication of the combination. According to Doguet's description, Reliquiae Farlowianae 56 is identical with specimens which I have examined. Doguet observed the similarity in shape of the ascospores of this species and *Melanospora barbata* (Fr.) Dur. and Mont. (cf. Barr, 1959), but recognized that the carbonaceous

walls of the perithecia differed entirely from the soft, thin wall of *Melanospora.*

Within the genus *Phaeostoma, P. sphaerophila* differs from the three previously described species in habit, in two-spored asci, and in differently shaped ascospores. *P. vitis* (Fckl.) Arx and Mueller, the type species, occurs on rotting roots of various plants such as *Vitis* and *Humulus,* has four-spored asci and spores which are 5-6 x 3-4 μ, ellipsoid to ovoid, with a germ pore at the lower end. *P. juniperina* (Ellis and Everh.) Arx and Mueller occurs on species of *Juniperus* and forms gall-like growths on twigs. It has six- to eight-spored asci, with ellipsoid to globose spores 3-4 μ in diameter, and a small germ pore. *P. lagenarium* (Pers. ex Fr.) Munk develops on old fruiting bodies of *Polyporus.* The asci are four-spored, the spores 13-16 x 7-10 μ with apiculus and germ pore at each end.

The recent publication of Wehmeyer's Monograph of *Pleospora* and its segregates (1961) is of great value in the determination of these fungi. Included here are records of three species of *Pleospora,* to extend our knowledge of the distribution of these fungi.

Pleospora calvescens (Fr.) Tul., Sel. Fung. Carp. 2: 266. 1863.

Additional synonym: *Leptosphaeria eutypoides* Peck, N. Y. St. Mus. Rep. 38: 105. 1885. Type material from the Peck Herbarium at Albany, collected by C. H. Peck, on dead stems of *Chenopodium album,* W. Albany, **New York,** May, 1884, agrees in all respects with Wehmeyer's description of *P. calvescens.* The spores are three-septate and lack a vertical septum, which undoubtedly influenced Peck in his choice of the generic name.

Pleospora laricina Rehm, Hedwigia 21: 121. 1882. var. **laricina.**

On branches of *Cornus florida,* Amherst, **Mass.,** Aug. 10, 1959, *Barr 2619.*

Pleospora straminis Sacc. and Speg., Michelia 1: 407. 1879.

On overwintered stalks of *Zea mays,* North Amherst, **Mass.,** April 29, 1959, *Barr 2549.* This collection has spores somewhat broader (10.5-15 μ) than does *P. straminis,* and approaches *P. pulchra* Kirschst. in that respect. However, the spores are shorter than in *P. pulchra,* have fewer septa, and are less strongly asymmetrical. Both species occur on reddish spots on the substrate, as does my collection.

On leaves of *Carex* sp., Mt. Albert, Gaspé Parc, **Quebec,** July 11, 1957, *Barr 2020.* Although the substrate was not reddened, this collection is otherwise identical with that on *Zea,* and with Wehmeyer's description.

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THE NOSEBURN (TRAGIA, EUPHORBIACEAE) OF WESTERN TEXAS

Marshall C. Johnston

Widespread in the arid grasslands and brush of northern Mexico, north to Arizona, Colorado, and Kansas, occur the humble, nondescript, stinging herbs which the English-speaking natives usually call stinging-nettle, and the Spanish-speaking natives *chichicastle*, a term also loosely applied to several stinging herbs. A more specific name, applied by some cowmen in western Texas, is noseburn, an allusion to the effect of the plants on stock. Noseburns are often quite abundant in grazed grasslands, and are among that great retinue of noxious, toxic or unpalatable plants which flourish under the abusive practices of overstocking which are the rule rather than the exception in the rangelands of western Texas. Noseburns can be recognized among our other genera of this family by the weak, trailing or even vine-like stem, the stinging hair, the serrate leaf,

and especially the placement of the short androgynous raceme which is actually terminal, but in development is quickly surpassed by the branch from the axil of the immediately subtending leaf, and thus appears nodal (it has been described as axillary, though it rises on the opposite side of the stem from the leaf).

The habit, leaves, inflorescences, and flowers of our noseburns are somewhat variable. On the basis of combinations of various quantitative characters such as texture of style and narrowness of leaf the German monographers Mueller Argoviensis (1866: 930-935) and Pax and Hoffman (1919: 33-52), the latter of whom tended to follow the former slavishly and uncritically, have discerned at least 9 taxa, species and varieties, among our noseburns. Even more curiously, they distribute these taxa into two different sections of the genus. A synoptic key to these sections may appear more or less as follows, and I say "more or less" because the species descriptions given by these authors contradict the characters given for the more inclusive taxa, and I have had to compile and modify to obtain a clearer picture:

Stamens (1—)3(—rarely 4); filaments free or united at the very base; rudiment very small or rarely absent; staminate calyx 3-parted or less commonly 4-parted; pistillate calyx 6-parted or rarely fewer-parted ..... *Tragia* Sect. *Tragia.*

Stamens (3—)4—6(—8 or even rarely 20); filaments commonly coherent; rudiments small or absent; staminate calyx 4- or 5-parted; pistillate calyx 5- or 6-parted .... *Tragia* Sect. *Leucandra* (Klotzsch) Muell. Arg.

Perhaps their haste, governed by the magnitude and ambitiousness of their task, and the paucity of American material available to them, can explain their acceptance of such weak categories.

Exomorphic studies of a large amount of material in the herbarium and in the field in many parts of Mexico and western and southern Texas permit the following statements. The number of stamens is usually 3, but varies to 4 even in the same raceme. The staminate calyx is usually

3-lobed, but again varies to 4-lobed even in the same raceme. Often, after a raceme has produced a number of staminate flowers, the meristematic tip ceases to produce normal flowers, and does not elongate further, but produces a terminal "flower ", probably representing the monstrous joining of 2 or more flowers, with 5 or more sepals and 5 to 6 or more stamens (such "flowers" could have been the basis of species and varieties of the "Sect. Leucandra" in our area). Our noseburns commonly have the filaments coherent basally around a minute central rudiment. The pistillate calyxes are usually 6-lobed but sometimes only 5-lobed. The various quantitative characters used by the monographers to distinguish species and varieties occur in every conceiveable combination and recombination. No combination of such traits shows the broadscale geographic restriction upon which a subspecies or variety could be founded. Furthermore, the variability in our noseburns is not greater than that encountered in many weedy widespread species of a number of other genera and families.

Our noseburns belong to a single species. Among the congeries of names thus thrown together, the one with priority is *Tragia nepetifolia.* McVaugh (1961: 202-203) says that this name has been "loosely interpreted," and that further study is needed. A study of material from near the type locality, in the state of Hidalgo, convinces me that the referral of our noseburns to *T. nepetifolia* by Harrington (1954) and Shinners (1958 and 1961) and other writers of floras does not represent a loose or incorrect interpretation. The synonymy and typification are as follows:

Tragia nepetifolia Cav. Icones Pl. 6: 37, t. 558, f. 1. 1801.

Between Ixmiquilpan and Zimapán, Hidalgo, *Sessé and/or Mociño* (MA?, F?). If no authentic herbarium material exists, the original illustration will serve as type. Cavanilles misspelled the name "nepetaefolia." *T. ramosa* Torr. Ann. Lyc. N. Y. 2: 245. 1828. Sources of the Canadian River, *James exs. 407* (NY?). *T. nepetaefolia* var. *ramosa* (Torr.) Muell. Arg. DC. Prodr. 15(2): 934. 1866. *T. angustifolia* Nutt. Trans. Amer. Phil. Soc. n.s. 5: 172. 1835. On the prairies of Red River, in arid situations, prcbably Choctaw County, Oklahoma, Nuttall, end of May, 1819 (BM?, apparent isotype seen labeled merely "Red River, Arkansas," PH). *T. teucriifolia* Scheele, Linnaea 25: 586. 1853.

New Braunfels, Comal County, Texas, *Lindheimer*, July-Sept., 1846 (B?). Blankinship (1907: 148) indicates that the type collection has the *exs. No. 522* (Lindheimer field *No. 299*); but the material which reached Scheele probably was not numbered the same as Blankinship's series at MO. *T. nepetaefolia* var. *teucriifolia* (Scheele) Muell. Arg. DC. Prodr. 15(2): 934. 1866. *T. scutellariaefolia* Scheele, Linnaea 25: 587. 1853. New Braunfels, Comal County, Texas, *Lindheimer* in July 1846 (B?); Blankinship (1907: 148) says the type is numbered *exs. 521* (*Lindheimer 298*). *T. stylaris* var. *angustifolia* Muell. Arg. Linnaea 34: 180. 1865. The type bore the same exsiccatae number as the last. *T. nepetaefolia* var. *scutellariaefolia* (Scheele) Muell. Arg. DC. Prodr. 15(2): 934. 1866. *T. ramosa* var. ? *leptophylla* Torr. Bot. Mex. Bound. p. 201. 1859. "Near Howard's Springs; *Bigelow;* No. 1796, *Wright.*" *T. stylaris* var. *leptophylla* (Torr.) Muell. Arg. Linnaea 34: 181. 1865. *T. nepetaefolia* var. *leptophylla* (Torr.) Shinners, Southw. Nat. 6: 101. 1961. *T. stylaris* Muell. Arg. Linnaea 34: 180, 1865. Novo Mexico, "*Wright 776*", according to Mueller, but this is probably *Fendler 776*, as listed by Torrey (1859: 201), "On the upper Rio Grande, New Mexico," and the type also of *Tragia stylaris* var. (alpha) *latifolia* Muell. Arg. Linnaea 34: 180. 1865. *T. nepetaefolia* var. *latifolia* Muell. Arg. DC. Prodr. 15(2): 934. 1866. Novo Mexico [probably western Texas], *Wright exs. 1794;* Mueller also cites three Mexican collections, *Aschenborn, Hartweg 82,* and *Virlet d'Aoust 121* (all G?). *T. nepetaefolia* var. *amblyodonta* Muell. Arg. DC. Prodr. 15(2): 934. 1866. Novo Mexico [probably western Texas], *Wright exs. 1793* (G?). *T. amblyodonta* (Muell. Arg.) Pax & K. Hoffm. Pflanzenr. IV 147 IX (Heft 68), p. 51, 1919. *T. scandens* M. E. Jones, Extr. Contr. West. Bot. 18: 49. 1933, non Muell. Arg. 1865, synonymy fide C. V. Morton, Contr. U. S. Nat. Herb. 29: 108-109. Guaymas, Sonora, *M. E. Jones 23300,* Jan. 26, 1927 (POM). [Morton's synonymy must be regarded as tentative.] *Tragia nepetaefolia* var. *angustifolia* Muell. Arg. DC. Prodr. 15(2): 934. 1866. Texas, *Berlandier 2542* (G?). The specimen was taken between Matamoros and Goliad, southern Texas, in April or May, 1834.

Perennial herbs 5-35 cm. tall with short white rigid stinging hairs; taproot 1-5(-12) mm. thick, brownish-white, often contorted; stems few to many from the woody crown, the lower parts often buried, brownish-white, resembling branched rootstocks; lower aerial stems 1-2 mm. thick, 5-50 cm. long, often purplish-green basally, green to grayish-green distally, weak and trailing or decumbent or even erect (ours never twining), profusely alternately branched; branches not greatly diverging; internodes 0.6-3(-9) cm. long. Leaves alternate; blades linear-lanceolate to deltoid or even reniform, with or without weak hastate lobes basally, or even ovate, 1-4.5 cm. long (or slightly longer in Val Verde County specimens), 0.7-6(-9) times as long as broad, apically acute, basally truncate to cordate, marginally sharply serrate, thin, green, pubescent; petioles slender, 2-10(-15) mm. long

(or to 30 mm. in Val Verde County) on lower leaves and often at an angle to the blade, 1-2(-4) mm. long on upper leaves, parallel to blade; stipules lanceolate, acute, entire, ca. 1-2.5 (-3.3) mm. long, green but persistent and drying brown, glabrate. Flowers monoecious, in androgynous ascending peduncled racemes 1.5-5 cm. long, at the nodes opposite the leaves (actually terminal and quickly surpassed by the branch from the axil of the subtending leaf, this branch parallel to the previous internode, thus appearing as a continuation of a single main stem); peduncles 1-10 mm. long; the single, lowermost node pistillate, the remainder 3-20+ nodes staminate, with internodes 0.5-1.8 mm. long; bracts oblanceolate, subcucullate, ca. 1-2 mm. long, acute, pubescent, entire. Staminate flowers: pedicels slender, 0.6-2 mm. long, with zone of abscission near middle, the lower part persistent; sepals 3-4 (usually 3 but varying even on same raceme), valvate in bud, oblanceolate to narrowly obovate-oblong, 1-1.7 mm. long, glabrous or sparingly pubescent dorsally, spreading or reflexed at anthesis; petals none; glands none; stamens 3-4, usually 4 but varying even on same raceme [note that the terminal "flower" (probably representing the monstrous joining of 2 or more flowers and not noticed until the raceme is considerably elongated) sometimes has 5+ sepals and 5-6+ stamens, as contrasted with the truly axillary flowers, and as described for *T. stylaris*]; filaments thickened and fleshy, ca. 0.4-0.5 mm. long, connate basally; rudiment none or a minute central eminence between the connate portions of the filaments. Pistillate flowers: pedicels ca. 1 mm. long, elongating to 2-3 mm. in fruit; sepals 5-6, usually 6, imbricate in bud, elliptic-lanceolate, ca. 1-1.5 mm. long at anthesis, ca. 2-2.5 mm. long in fruit, acute, entire, hispid dorsally; petals and glands none; ovary nearly round, densely long erect hispid; styles 3, connate a third their lengths, 2-4 mm. long, entire, papillate-fungoidal on the adaxial surface, coiling outward apically after anthesis, often reddish or purplish. Capsules distinctly roundly tricoccous, ca. 3.5-4 mm. long, ca. 6-7 mm. broad, densely erect-hispid; columella slender, whitish, 2-2.4 mm. long, with 3 long interlocular points apically. Seeds nearly spherical, ca. 2.7-3.5 mm. long, when mature brownish black with tawny tinge or mottling; surficially smooth but not shiny; ecarunculate.

These plants occur from Veracruz, Hidalgo, San Luis Potosí, and Zacatecas, north to Missouri, Kansas, Colorado, and Arizona; and perhaps much farther south and east (cf. McVaugh 1961: 202-203). They occur in a great variety of circumstances, but are particularly abundant in grasslands at moderate elevations and have been collected at elevations up to 8000 feet in the Guadalupe Mountains of Culberson County, Texas. — THE PLANT RESEARCH INSTITUTE, THE UNIVERSITY OF TEXAS, AUSTIN.

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A NEW SPECIES OF HAPLOPAPPUS, SECTION BLEPHARODON

RAY C. JACKSON

Haplopappus texensis sp. nov.

Herba perennis 3-7 dm. alta; caulibus pluribus (vel unica), erectis, striatis, tomentosis vel glabratis in maturitate; foliis alternis, sessilibus, ad 7 cm. longis et 1.3 cm. latis, oblanceolatis, lobis dentibusque ad apeces spinuloso-mucronatis, insuper in maturitate sparse tomentosis vel glabratis, subtuse tomentosis; capitulis pluribus, cymosis; disco dia. 5-8 mm., receptaculis fimbriatis; phyllariis anguste lanceolatis, acuminatis, ad apeces spinulosis, dorsis tomentosis, ca. 5 mm. longis et 1 mm. latis; radiis 22-28, 1-1.5 cm. longis; disci corollis glabris, 5.5-6 mm. longis; achaeniis turbinatis, pubescentis, 2.4-2.8 mm. longis; pappis 6-6.8 mm. longis.

Perennial herb, 3-7 dm. tall, stems one to several, erect, striate, tomentose or glabrate with age; leaves alternate, sessile, up to 7 cm. long and 1.3 cm. wide, oblanceolate, the basal ones lobed, the median ones dentate, lobes and teeth spinulose-mucronate, sparsely tomentose above or glabrate with age, tomentose below; heads several, cymosely arranged; disc diam. 5-8 mm., receptacle frimbriate; phyllaries narrowly lanceolate, acuminate, tomentose on the backs, spinulose at the

tips, about 5 mm. long and 1 mm. wide; rays 22-28, 1-1.5 cm. long; disc corollas glabrous, 5.5-6 mm. long; pappus 6-6.8 mm. long. Chromosome number $n = 4$.

TYPE: Brooks County, Texas, sandy soil along railroad right-of-way about 7.5 miles south of Falfurrias, *Jackson 2938-1* (KANU), August 7, 1959.

Haplopappus texensis is thus far known only from the type locality where several hundred plants were observed. A number of plants have been under cultivation since the species was first collected in late August of 1957. Numerous attempts to cross the species with morphologically related taxa of the *Blepharodon* section of *Haplopappus* have been unsuccessful.

On gross morphological characters, *H. texensis* may be distinguished from related perennial species by its erect growth habit, greater height, and less deeply divided leaves.

— UNIVERSITY OF KANSAS, LAURENCE, KANSAS

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AGROPYRON HYBRIDS AND THE STATUS OF AGROPYRON PSEUDOREPENS[1]

RICHARD W. POHL

A number of specimens of *Agropyron* from Iowa (listed in Table 1) have rhizomes similar to those of *A. repens* (L.) Beauv. or *A. smithii* Rydb., but bear narrow spikelets with enlarged, persistent glumes, resembling those of the cespitose *A. trachycaulum* (Link) Malte. Examination of these specimens shows that they have low seed set, ranging from 0-67% in the specimens examined. Pollen from these specimens was mounted in lacto-phenol and cotton blue. It was found that the pollen of each of these specimens was collapsed, shrunken, and without stainable contents. (See Figure 1).

[1]Journal paper J-4249 of the Iowa Agricultural and Home Economic Expt. Station, Ames. Project 1136. The facilities of the Iowa State University Herbarium, supported by the Industrial Science Research Institute, were used in this study. The author wishes to acknowledge the loan of specimens from the U. S. National Herbarium, Jason R. Swallen, Head Curator, and from The Gray Herbarium.

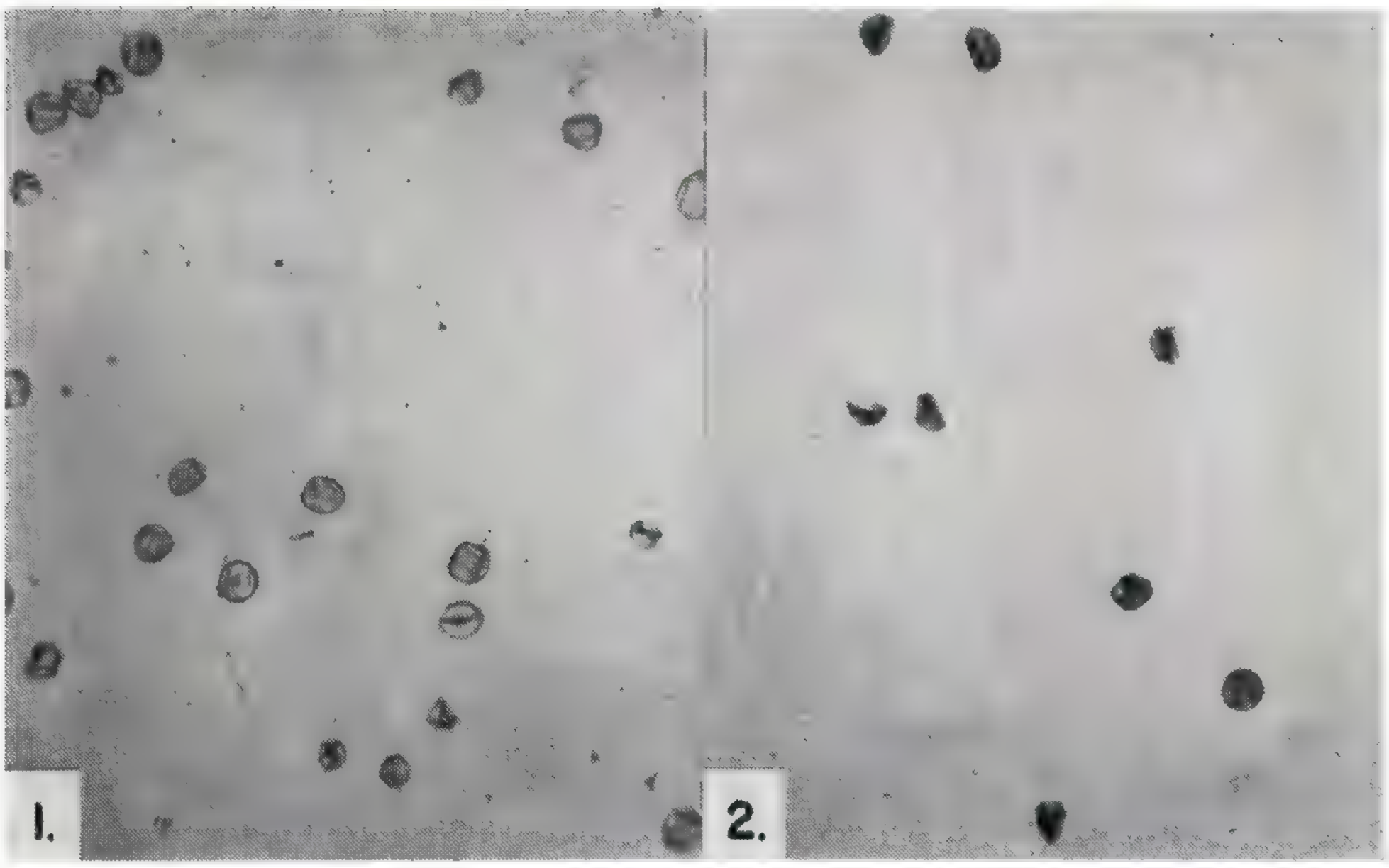

Figure Legend

Fig. 1-2. Pollen of *Agropyron* hybrids: Fig. 1. McDill 295 (*repens* × *trachycaulum*) Fig. 2. Rydberg 2018 (Type of *A. pseudorepens*)

Hubbard (1954) reported male-sterile hybrids of *A. repens* with other species in Great Britain. He stated that *A. repens* is self-sterile. Gillett and Senn (1960) have also found self-sterility in the American rhizomatous species, *A. smithii* Rydb. Many of our weed infestations of *A. repens* probably have originated from single seeds, followed by extensive vegetative spread. The absence of pollen of other genetic strains of *A. repens* near such a colony would make crossing with other species quite probable. Since *A. trachycaulum* is the only other common species of *Agropyron* in Iowa, and since the pollen sterile plants are morphologically similar to *A. trachycaulum*, the latter is probably the male parent of these putative hybrids. Since the hybrids were detected by the presence of rhizomes, other specimens of similar origin but lacking rhizomes may have been undetected. This cross may have occurred much more frequently than we are able to tell from herbarium records.

These pollen-sterile specimens key to *A. pseudorepens* Scribn. and Smith in Hitchcock's Manual. Fernald (1933) regarded this "species" as belonging to *A. trachycaulum*,

var. *majus* (Vasey) Fern. Beetle (1952) designated it as *A. trachycaulum*, var. *majus*, f. *pseudorepens* (Scribn. & Smith) Beetle.

The material of *A. pseudorepens* in the U. S. National Herbarium was examined. The type specimen (Rydberg 2018, from Kearney, Nebraska; U.S. 556663) bears rhizomes and has leaf blades strongly ridged above. The glumes are broad, strongly ridged, and nearly as long as the spikelets. Morphologically, the type is intermediate between *A. trachycaulum* and *A. smithii*. Pollen taken from the anthers of the type specimen is collapsed and shrunken (See Fig. 2). The type of *A. pseudorepens* is therefore a probable male-sterile hybrid of *A. trachycaulum* and *A. smithii*. Both species are known from Nebraska. The name *A. pseudorepens*, if used, should be applied only to such hybrids. It is not applicable to the Iowa hybrids, which are of other parentage.

Examination of other rhizomatous specimens of "*A. pseudorepens*" from the collections of the U. S. National Herbarium, cited in Table 2, revealed many instances of total pollen sterility. Such specimens may also represent hybrids of various rhizomatous species of *Agropyron* with the widespread *A. trachycaulum*.

Table 1. *Agropyron repens* × *A. trachycaulum* in Iowa

Specimen	% seed set	Pollen
Mason City. August 12, 1922 *L. H. Pammel*, (ISC 106233)	0	sterile
Dickens, Clay Co. *J. Fults 2908* (ISC)	67	sterile
Dickinson Co., August 1921, *R. I. Cratty*, (ISC 97682)	11	sterile
Hayden Prairie, Howard Co., *R. C. McDill 295* July 9, 1952 (ISC)	—	sterile
Kossuth Co., Wesley Twp., July 21, 1951, *R. W. Pohl 7136* (ISC)	33	sterile

Table 2. Pollen sterility in "*Agropyron pseudorepens*"

Specimen	% sterile pollen (100-400 grain samples)	
Nebraska		
Kearney. P. A. Rydberg 2018 (TYPE) (US)	100	No caryopses
Kearney. C. L. Shear 272 (TOPOTYPE) (US)	100	No caryopses
Wyoming		
Mt. Washburn, Yellowstone N. P. A. S. Hitchcock 2051 (US)	100	
Road Ranch. Williams & Griffiths 43, 44 (US)	100	
Bear Lodge Mts. D. Griffiths 944 (US)	Completely sterile; no flowers	
Colorado		
Sheephorn Divide. Shear & Bessey 1551 (US)	100	
Florissant. T. A. Williams 2147 (US)	98	
Jarosa Canyon. Agnes Chase 5389 (US)	0	
New Mexico		
Copper Mines. J. M. Bigelow. Oct. 23, 1851 (US)	93	
Los Alamos. Arsene & Benedict 17155 (US)	86	
Near Magdalena. J. R. Swallen 1151 (US)	68	
White Mt. Peak. Wooton. Aug. 1, 1901 (US)	93	
Alberta		
Thelma. J. L. Bolton. July 16, 1936 (US)	100	
Utah		
Manti N. F., A. S. Hitchcock 10895 & 10899 (US)	100	
Arizona		
Spring below McKay Creek, Apache Res. Goodding & Schroeder 330-41 (US)	100	
San Francisco Mts., 13 mi. e. of Flagstaff. K. F. Parker 5999 (US)	100	
Oregon		
Silvies River to Burns. D. Griffiths & B. Hunter 219 (US)	88	

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CHROMOSOME NUMBERS FOR SOME ANGIOSPERMS OF THE SOUTHERN UNITED STATES AND MEXICO

Walter H. Lewis, H. Larry Stripling[1], and Richard G. Ross[2]

Chromosome numbers are reported for 34 families including 57 genera and 73 species and varieties collected in the southern United States and Mexico. The chromosomes of one family, Turneraceae, and of 17 genera are given for the first time. The new generic reports include those for: *Brunnichia* (Polygonaceae), *Cnidoscolus* (Euphorbiaceae), *Cliftonia* (Cyrillaceae), *Piriqueta* (Turneraceae), *Rotala* (Lythraceae), *Samolus* (Primulaceae), *Halesia* (Styraceae), *Cynoctonum* (Loganiaceae), *Sabatia* (Gentianaceae), *Bonamia* (Convolvulaceae), *Pycnanthemum* (Labiatae), *Bacopa*, *Buchnera*, *Lindernia*, *Mecardonia*, *Trigiola* (Scrophulariaceae), and *Sphenoclea* (Campanulaceae). In addition, the first definite chromosome numbers are recorded for *Apios* (Leguminosae) and *Utricularia* (Lentibulariaceae). Among

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[2]Undergraduate Research Participant during 1960-61, Stephen F. Austin State College, under the direction of the senior author (National Science Foundation, G-12059).

the 73 species and varieties listed, 53 are new chromosome reports, 4 conflict with previous results, and 16 are verifications of earlier counts.

The families are listed according to Cave (1956-60), except that the Smilacaceae and the Krameriaceae are separated from the Liliaceae and the Leguminosae, respectively. The genera and species are reported alphabetically within families. For each taxon the following data are given: (a) an asterisk after the name if this is the first reported number or if it is at variance with a previous record; (b) somatic and/or gametic numbers from premeiotic cells and/or PMCs, unless otherwise indicated; (c) figure number if the chromosomes are illustrated; (d) voucher with locality, collector, and citation of herbarium where deposited; (e) number of plants studied when more than one; and (f) name of taxonomist who determined voucher if not by the authors. When pertinent a brief discussion and reference to earlier work is also added.

Most of the chromosome numbers were obtained from PMC meiosis and premeiotic mitosis of immature buds fixed in the field. Occasionally, root tips, pretreated for 2-3 hours in paradichlorobenzene, and pollen mitosis served as the basis for the chromosome reports. For some species plants from more than one locality were sampled and when possible more than one from each population. All material was fixed in modified Carnoy's (4: 3: 1) and stained in either 1% acetic-orcein or 1% iron aceto-carmine. Chromosomes were drawn with the aid of a camera lucida originally at X 2300 and reduced by ca. 2/5 in reproduction.

CYPERACEAE

Eleocharis obtusa (Willd.) Schultes*: **n = 5** (pollen mitosis), fig. 1. Texas. Panola Co., Lake Murvaul, *Hull 7* (SMU).

XYRIDACEAE

Xyris elliottii Chapm.*: (1) **n = 9.** Florida. Citrus Co., 0.4 miles N of Citrus-Hernando Co. line, *Lewis 5653* (VPI). (2) **n = 9**, fig. 2. Florida. Glades Co., 8.6 miles SE of Palmdale, *Lewis 5684* (VPI). Determined by Dr. Robert Kral.

X. torta Sm.: **n = 9**, fig. 3. Virginia. Augusta Co., ca. 2.5 miles SW of Sherando, *Kral 13394* (VPI). Determined by the collector. Verification of Lewis (1961) for a plant allied to *X. torta* but thought to represent a new taxon.

COMMELINACEAE

Commelina erecta L. var. *angustifolia* (Michx.) Fern.*: **n = 30**, fig. 4. Texas. Nacogdoches Co., 1.4 miles NW of Nacogdoches, *Stevens 10* (SMU).

C. diffusa Burm. f.: **2n = 30**, fig. 5. Texas. Nacogdoches Co., Nacogdoches, *Stevens 17* (SMU, TEX). Verification of Simmonds (1954), but not that of Morton (1956) who found $2n = 28$ chromosomes for west African material.

C. virginica L.*: **n = 30**. Texas. Nacogdoches Co., Angelina River and Hwy. 21, Stevens 16 (SMU, TEX).

Tradescantia navicularis Ortgies*: **n = 24** (first pollen mitosis), fig. 6. MEXICO. Nuevo Leon. 15.2 miles E of Hwys. 57 and 60 junction, *Lewis 5756* (SMU). Determined by Dr. Harold E. Moore, Jr. Darlington (1929) reported $n = 16$ ($4x$) for this taxon, which suggests that our material is part of a hexaploid race or that Darlington's plant was a second species. This is the first record of *T. navicularis* from Nuevo Leon.

T. ohiensis Raf.: **n = 12** (first pollen mitosis). Arkansas. St. Francis Co., 1.5 miles N of Goodwin, *Lewis 5611* (SMU). Verification of the $4x$ race recorded by Anderson and Sax (1936) under *T. canaliculata* Raf.

T. reverchoni Bush: **n = 12** (first pollen mitosis). Texas. Nacogdoches Co., 2 miles NE of Nacogdoches, *Stevens 9* (SMU, TEX). Verification of Brown *et al.* (1951).

SMILACACEAE

Smilax glauca Walt.*: **2n = 32**. Texas. Nacogdoches Co., Angelina River and Hwy. 21, *Ross 70* (SMU, TEX). Jensen (1937) recorded $n = 14$ chromosomes for *S. glauca* which on the basis of this count, and for others of closely related species, seems to be in error.

S. bona-nox L.*: **2n = 32**, fig 7. Texas. Panola Co., 2.3 miles NE of Pinehill, *Lewis 5718* (SMU, TEX); 2 plants studied.

AMARYLLIDACEAE

Ipheion uniflorum (Graham) Raf. **2n = 12** (root tips). Bulbs received from Dr. L. H. Shinners, originally from the Oakhurst Gardens, Arcadia, California, *Lewis 5434* (SMU). Verification of Saez (1949) under *Brodiaea*.

LORANTHACEAE

Phoradendron bolleanum (Seem.) Eichl.*: **2n = 28**. Texas. Brewster Co., Big Bend National Park, *Lewis & Oliver 5452* (SMU). Without

pretreatment the metaphase chromosomes vary in length from 13.4 μ to 33.6 μ for the longest pair. Bowden and Speese (1957) noted the exceptional length of chromosomes for *P. flavescens* [= *P. serotinum* (Raf.) M. C. Johnst.] even after pretreatment for 24 hours.

POLYGONACEAE

Brunnichia cirrhosa Gaertn.*: **n = 24**, fig. 8. Texas. Nacogdoches Co., 1 mile E of Martinsville, *Oliver 62* (SMU).

PHYTOLACCACEAE

Phytolacca americana L.: **n = 18**. Texas. Nacogdoches Co., Stephen F. Austin Experimental Forest, *Ross 82* (ASTC). Verification of $2n = 36$ by Suzuka (1950).

PORTULACACEAE

Claytonia virginica L.: (1) **n = 12**, fig. 9. Kentucky. Warren Co., 0.7 miles NW of Petros, *Lewis 5606* (SMU); 2 plants studied. (2) **n = 36**, fig. 10. Kentucky. Green Co., 1.4 miles NW of Greensburg, *Lewis 5603* (SMU); 2 plants studied. PMC meioses of both plants from the first population were regular, but those from the second population were highly abnormal in behavior. The following configurations from two plants were noted at metaphase I: 35 II + 2 I, 34 II + 4 I, 33 II + 6 I, 32 II + 8 I, 34 II + 1 III + 1 I, 33 II + 1 III + 3 I, 30 II + 1 III + 7 I, and 32 II + 1 IV + 4 I. These variations in chromosome number and in meiotic behavior are not surprising in view of the results of Rothwell (1959) and of Lewis (1962).

RANUNCULACEAE

Aquilegia canadensis L. var. *australis* (Small) Munz*: **2n = 14**, fig. 11. Florida. Jackson Co., 3 miles N of Marianna, *Mitchell 27* (FSU); 2 plants studied. This variety is known only from the Marianna Red Hills region of Florida.

Isopyrum biternatum (Raf.) T. & G.*: **2n = 14**, fig. 12. Florida. Jackson Co., 3 miles N of Marianna, *Mitchell 1* (FSU); 2 plants studied.

MENISPERMACEAE

Cocculus carolinus (L.) DC.: **n = 39**. Texas. Nacogdoches Co., Nacogdoches, *Ross 42* (SMU). Verification of Bowden's (1945) $2n = 78$.

CRUCIFERAE

Cardamine bulbosa (Schreb.) B.S.P.*: **2n = 64**. Texas. Shelby Co., 2 miles SW of Timpson, *Lewis 4998* (SMU).

Lesquerella purpurea (Gray) Wats.*: **n = 9, 2n = 18**, fig. 13. Texas. Brewster Co., Big Bend National Park, *Ross 50* (SMU, TEX).

SAXIFRAGACEAE

Ribes echinellum (Cov.) Rehd.* (*Grossularia echinella* Cov.): **2n = 16**, fig. 14. Florida. Leon Co. Tallahassee, cultivated, *Stripling 779* (FSU). The Florida gooseberry is endemic to the Lake Miccosukee region in Jefferson Co.; this plant was studied after transplanting to Tallahassee.

LEGUMINOSAE

Apios americana Medic.*: **n = 11**, fig. 15. Texas. Nacogdoches Co., Nacogdoches, *Redus 15* (SMU); 2 plants studied. This number does not agree with that found by Atchison (1949), and reported under the synonym *A. tuberosa* Moench., and undoubtedly her number of $2n$ = ca. 40 refers to another taxon. The basic number for *Apios* is $x = 11$.

Centrosema virginianum (L.) Benth.*: (1) **n = 9**, fig. 16. Texas. Naccgdoches Co., Nacogdoches, *Redus 1* (SMU, TEX); 2 plants studied. (2) **n = 9**. Texas. Nacogdoches Co., Angelina River and Hwy. 21, *Redus 13* (TEX): 2 plants studied. These counts add a new basic number of $x = 9$ to the genus, a number rare in the Leguminosae.

Desmodium canescens (L.) DC.: **n = 11**, fig. 17. Texas. Nacogdoches Co., Nacogdoches, *Redus 9* (SMU, TEX). Verification of Young (1940).

Erythrina herbacea L.: **2n = 42**. Texas. Nacogdoches Co., Nacogdoches, *Lewis & Oliver 5234* (ASTC). Verification of Atchison (1947).

Galactia macreei Curtis*: **n = 10**, fig. 18. Texas. Nacogdoches Co., Nacogdoches, *Redus 6* (SMU).

KRAMERIACEAE

Krameria lanceolata Torr.: **n = 6**. Texas. San Patricio Co., 5 miles SE of Mathis, *Lewis & Jones 5589* (SMU). Verification of Turner (1958). At anaphase I, the longest chromosome measured 24.6 μ, the shortest 10.0 μ and the six averaged 17.3 μ. As noted by Turner, these chromosomes are among the longest known in the dicotyledons although those of *Phoradendron bolleanum* given above are even greater in length.

EUPHORBIACEAE

Cnidoscolus texanus (Muell. Arg.) Small*: **n = 18**, fig. 19. Texas. Nacogdoches Co., Nacogdoches, *Ross 66* (SMU).

Croton capitatus Michx. var. *lindheimeri* (Engelm. & Gray) Muell. Arg.*: **2n = 20** (root tips), fig. 20. Texas. Nacogdoches Co., Nacogdoches, *Lewis 4994* (ASTC).

CYRILLACEAE

Cliftonia monosepala (Lam.) Sarg.*: (1) **n = 10, 2n = 20**, fig. 21. Florida. Leon Co., 15 miles SW of Tallahassee, *Stripling 1007* (FSU); 2 plants studied. (2) **2n = 20**. Florida. Jefferson Co., 1.5 miles SW of Wacissa, *Stripling 1004* (FSU); 2 plants studied. (3) **n = 10**. Florida. Leon Co., Branch Bay, near Silver Lake, *Godfrey 60543* (FSU). (4) **2n = 20**. Florida. Wakulla Co., Spring Hill Road, SW of Tallahassee, *Godfrey 60544* (FSU). There are no previous counts for this family other than a report of $n = 20$ in most cells of *Cyrilla racemiflora* L. (Thomas, 1960). Thomas noted fast deterioration of fixed buds and this was found to be true for *Cliftonia*. Our best results were obtained no later than 2-4 days after fixation.

GUTTIFERAE

Hypericum sp.*: **n = 9, 2n = 18**, fig. 22. Florida. Washington Co., *Adams & Tyson 833* (FSU); 2 plants studied. A new specific name will be given to this collection by Dr. P. Adams, DePauw University.

H. microsepalum (T. & G.) Gray* [*Crookea microsepalum* (T. & G.) Small]: (1) **n = 9, 2n = 18**, fig. 23. Florida. Wakulla Co., 4 miles N of Sopchoppy, *Stripling 772* (FSU). (2) **2n = 18**. Florida. Leon Co., 6 miles S of Tallahassee, *Stripling 786* (FSU).

VIOLACEAE

Viola walteri House: **2n = 20** (root tips), fig. 24. Texas. Nacogdoches Co., Nacogdoches, *Lacey 3* (SMU, ASTC). Verification of Gershoy (1934).

TURNERACEAE

Piriqueta glabrescens Small*: **n = 7**, fig. 25 as 6 II + 2 I. Florida. Collier Co., 7.1 miles E of Napes, *Osborne 62* (FSU, SMU); 3 plants studied, mostly with 7 II. Determined by Dr. C. M. Rogers.

P. tomentosa HBK.*: **n = 7**, fig. 26. Florida. Monroe Co., Big Pine Key, *Osborne 66* (FSU); 3 plants studied. Determined by Dr. C. M. Rogers.

LYTHRACEAE

Rotala ramosior (L.) Koehne*: **n = 16**, fig. 27. Texas. Angelina Co., Angelina River and Hwy. 59, *Lewis & Oliver 5273* (SMU).

PRIMULACEAE

Samolus parviflorus Raf.*: **n = 13, 2n = 26**, fig. 28. Louisiana. St. Mary Par., 8.7 miles NW of Boyeau Vista, *Oliver 261* (SMU); 2 plants studied.

STYRACEAE

Halesia diptera Ellis. var *diptera**: **2n = 24**, fig. 29. Florida. Leon Co., Tallahassee, cultivated, *Stripling 732* (FSU).

H. diptera Ellis. var. *magniflora* Godfrey*: **2n = 24**, fig. 30. Florida. Leon Co., Tallahassee, cultivated, *Stripling 730* (FSU).

H. tetraptera Ellis.* [*H. parviflora* Michx., not *H. carolina (tetraptera)* as listed in Darlington & Wylie (1956), cf. Godfrey (1958)]: **2n = 24**, fig. 31. Florida. Leon Co., Tallahassee, cultivated, *Stripling 716* (FSU).

OLEACEAE

Menodora scabra Gray*: **n = 11**, fig. 32. Texas. Brewster Co., Big Bend National Park, *Ross 52* (SMU, TEX). This number does not agree with that of Taylor (1945) who found $2n = 44$ chromosomes. Perhaps $2x$ and $4x$ races exist for the species.

LOGANIACEAE

Cynoctonum mitreola (L.) Britt.*: **n = 10, 2n = 20**. Texas. Liberty

Co., 4 miles E of Cleveland, *Ross 73* (SMU, TEX); 2 plants studied. Determined by Dr. L. H. Shinners.

GENTIANACEAE

Sabatia campestris Nutt.*: (1) **n = 13**, fig. 33. Texas. Brazos Co., College Station, *Lewis 5494* (SMU). (2) **2n = 26**. Texas. Nacogdoches Co., Nacogdoches, *Lewis & Oliver 5233* (SMU).

CONVOLVULACEAE

Bonamia humistrata (Walt.) Gray*: **n = 14**, fig. 34. Texas. Panola Co., Sabine River and Hwy. 59, *Lewis & Oliver 5318* (SMU). Some PMCs were observed with 13 II + 2 I and still others with a trivalent at metaphase I.

B. pickeringii (Torr.) Gray*: (1) **n =14**, fig. 35. Texas. Rusk Co., 3.1 miles N of Cushing, *Lewis & Oliver 5279* (SMU). At least 50% of the PMCs had 13 II + 2I. (2) **2n = 28**. Texas. Nacogdoches Co., 0.5 miles W of Nacogdoches, *Lewis & McDaniel 5509* (SMU).

Jacquemontia abutiloides Benth.*: **2n = 18**. MEXICO. Baja California Sur. 3 km. S of Miraflores, *Lewis 5339* (SMU); 2 plants studied. Determined by Dr. L. H. Shinners.

LABIATAE

Pycnanthemum albescens T. & G.*: **n = 33-36**. Texas. Liberty Co., 2 miles E of Cleveland, *Ross 61* (SMU).

Salvia reflexa Hornem.*: **n = 10**, fig. 36. MEXICO. Nuevo Leon. 9.9 miles E of Hwys. 57 and 60 junction, *Lewis 5750* (SMU, TEX). Determined by Dr. L. H. Shinners.

Scutellaria cf. *integrifolia* L.*: **2n = 32**, fig. 37. Florida. Sarasota Co., 12 miles E of Sarasota, *Stripling 754* (FSU); 2 plants studied.

Stachys tenuifolia Willd.*: **n = 16**, fig. 38. Texas. Nacogdoches Co., Stephen F. Austin Experimental Forest, *Ross 56* (SMU, TEX).

SOLANACEAE

Nicotiana glauca Graham: **2n = 24**. MEXICO. Baja California Sur. 1.4 km. W of San José del Capo, *Lewis 5354* (SMU). Verification of Goodspeed (1923).

SCROPHULARIACEAE

Bacopa monnieri (L.) Pennell*: **2n = 64**, fig. 39. Texas. Harris Co., 2 miles E of Humble, *Lewis 5497* (SMU).

Buchnera americana L.*: **2n = ca. 42**. Texas. Jasper Co., 50 yards S of Hwys. 96 and 1004 junction, *Lewis 5623* (SMU).

Gratiola ramosa Walt.*: (1) **n = 7, 2n = 14**, fig. 40. Florida. Levy Co., 1 mile SW of Otter Creek, *Stripling 734* (FSU); 2 plants studied. **(2) n = 7, 2n = 14**. Florida. Wakulla Co., 3 miles E of Carabelle, *Stripling 781* (FSU); 2 plants studied.

G. aurea Muhl.*: **2n = 28**, fig. 41. Georgia. Cook Co., Little River bridge and Hwy. 76, *Adams 588* (FSU); 3 plants studied.

G. brevifolia Raf.*: (1) **n = 14, 2n = 28,** fig. 42. Florida. Leon Co., 7 miles SW of Tallahassee, *Stripling 794* (FSU); 3 plants studied. (2) **2n = 28.** Florida. Gadsden Co., 3 miles W of Ochlockonee River bridge and Hwy. 90, *Stripling 777* (FSU). (3) **2n = 28.** Florida. Jefferson Co., 4.5 miles E of Monticello, *Stripling 795* (FSU); 2 plants studied. (4) **n = 14, 2n = 28.** Texas. Liberty Co., 4 miles E of Cleveland, *Ross 77* (SMU, FSU); 2 plants studied.

G. virginiana L.*: **n =8, 2n = 16,** fig. 43. Florida. Leon Co., 6 miles SE of Tallahassee, *Stripling 705* (FSU); 3 plants studied.

These counts represent a part of a detailed study of the Gratiolas (s. l.) now in progress. A new basic number of $x = 7$ is reported for the genus and includes *G. ramosa*, *G. aurea*, and *G. brevifolia* in the section *Gratiolaria* while *G. virginiana* in the section *Nibora* belongs to a second line with $x = 8$ chromosomes.

Lindernia dubia (L.) Pennell*: **n = 16, 2n = 32,** fig. 44. Texas. San Augustine Co., 8.2 miles SE of San Augustine, *Lewis et al. 5500* (FSU).

Mecardonia acuminata (Walt.) Small*: **2n = 42 ± 2.** Texas. Cherokee Co., Angelina River and Hwy. 21, *Lewis et al. 5505* (SMU).

Scoparia dulcis L.*: **n = 10,** fig. 45. Texas. Liberty Co., 2 miles E of Cleveland, *Ross 62* (SMU, TEX). Raghaven & Srinivasan (1940) recorded a tetraploid number of $2n = 40$.

Tragiola pilosa (Michx.) Small & Pennell*: (1) **2n = 22,** fig. 46. Florida. Taylor Co., 9 miles W of Perry, *Stripling 883* (FSU); 2 plants studied. (2) **2n = 22,** Florida. Levy Co., 11 miles NW of Dunnellon, *Stripling 876* (FSU).

Veronica persica Poiret: **2n = 28,** fig. 47. Florida. Leon Co., Tallahassee, *Stripling 788* (FSU); 3 plants studied. Beatus (1936) recorded this number for *V. persica* in Europe, but there is some doubt as to the exact species he examined. Although not previously examined cytologically from the United States, our data verify counts from Canadian (Mulligan, 1959) and Icelandic (Löve & Löve, 1956) populations.

LENTIBULARIACEAE

Utricularia inflata Walt.*: (1) **n = 9, 2n = 18,** fig. 48. Florida. Leon Co., 1 mile E of Ochlockonee River and Hwy. 90, *Godfrey 59374*

FIG. 1-14. Chromosomes of angiosperms, X 1350. Fig. 1. *Eleocharis obtusa, Hull 7*, $n = 5$, with 3 degenerating nuclei; fig. 2. *Xyris elliottii, Lewis 5684*, $n = 9$; fig. 3. *X. torta, Kral 13394*, $n = 9$; fig. 4. *Commelina erecta* var. *angustifolia, Stevens 10*, $n = 30$; fig. 5. *C. diffusa, Stevens 17*, $2n = 30$; fig. 6. *Tradescantia navicularis, Lewis 5756*, $n = 24$; fig. 7. *Smilax bona-nox, Lewis 5718*, $2n = 32$; fig. 8. *Brunnichia cirrhosa, Oliver 62*, $n = 24$; fig. 9. *Claytonia virginica, Lewis 5606*, $n = 12$; fig. 10. *C. virginica, Lewis 5603*, $n = 36$ (29 II + 8 I + 2 III); fig. 11. *Aquilegia canadensis* var. *australis, Mitchell 27*, $2n = 14$; fig. 12. *Isopyrum biternatum, Mitchell 1*, $2n = 14$; fig. 13. *Lesquerella purpurea, Ross 50*, $2n = 18$; fig. 14. *Ribes echinellum, Stripling 779*, $2n = 16$.

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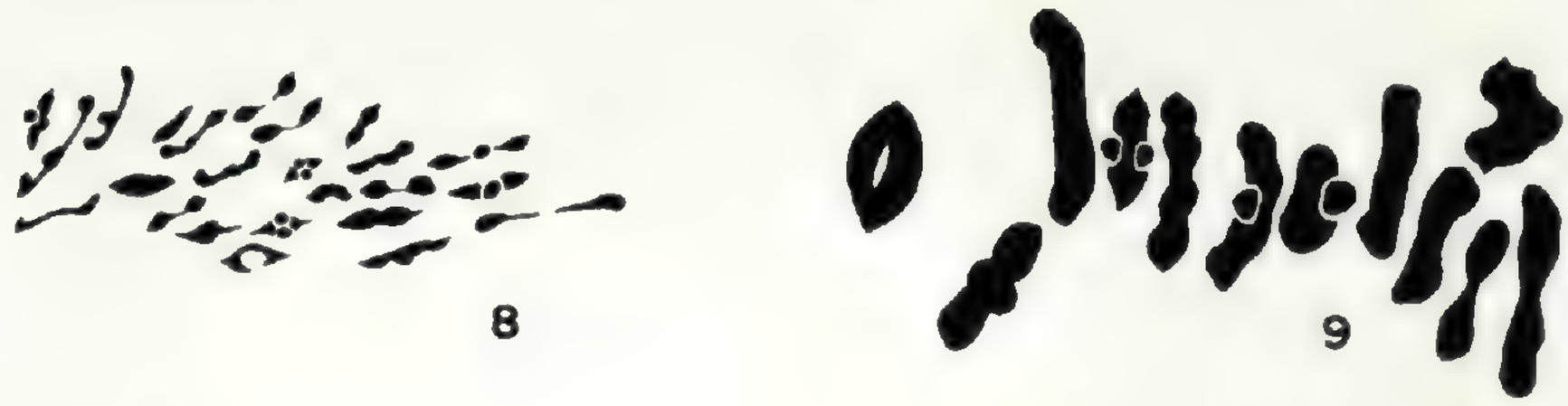
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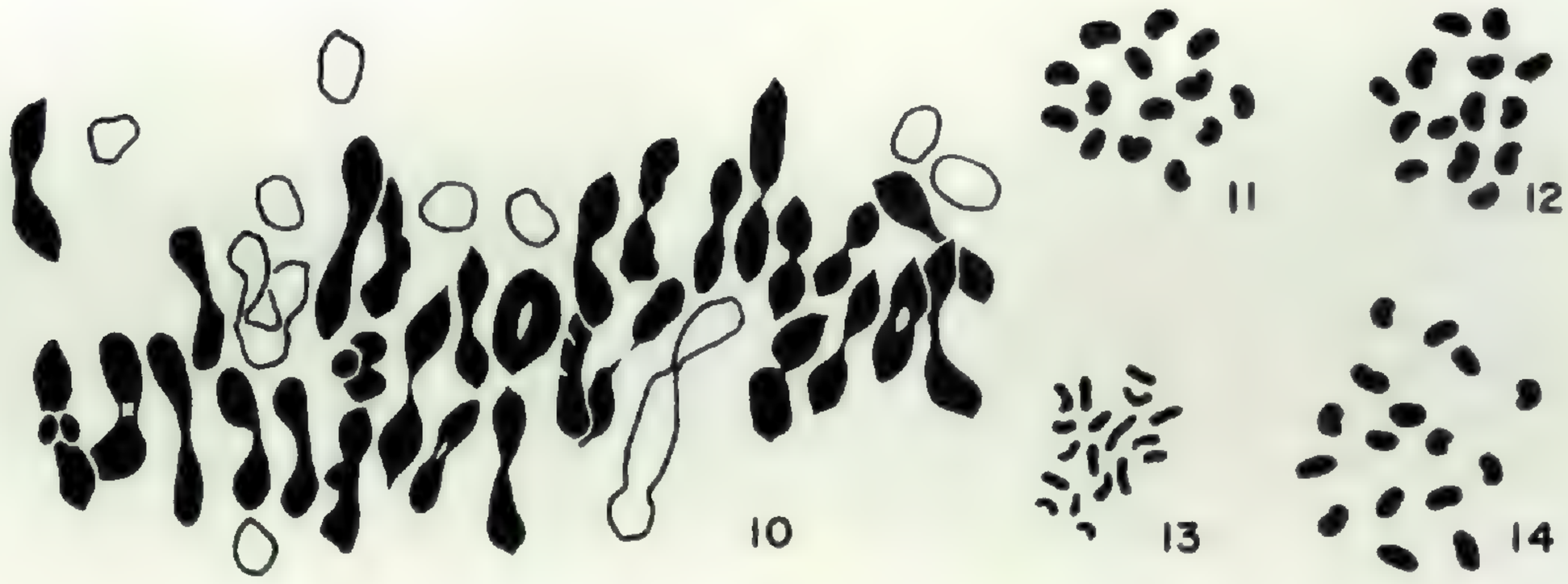
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(FSU); 3 plants studied. (2) **2n = 36**, fig. 49. Florida. Leon Co., 4 miles W of Tallahassee, *Reinert 2* (FSU); 2 plants studied. The previous numbers reported for *Utricularia* (cf. Darlington & Wylie, 1956) are all approximations, viz., $2n = 36$-40 or ca. 40 chromosomes. Our data establish $x = 9$ as a basic number for the genus and also record *U. inflata* as having $2x$ and $4x$ races.

ACANTHACEAE

Justicia lanceolata (Chapm.) Small*: (1) **n = 14**, fig. 50. Texas. Angelina Co., Angelina-Nacogdoches Co. line and Hwy. 301, *Lewis & Oliver 5320* (SMU). (2) **n = 14**. Texas. Angelina Co., Angelina River and Hwy. 7, *Lewis & Oliver 5325* (SMU). (3) **n = 14 + 1, 2n = 29**, fig. 51. Texas. Panola Co., 0.7 miles NE of Sabine River and Hwy. 59, *Lewis & Oliver 5309* (SMU). The single plant from the third locality consistently had 14 II + 1 I at meiosis I and an extra chromosome in the mitotic plates. The chromosome was small but not heteropycnotic.

CAMPANULACEAE

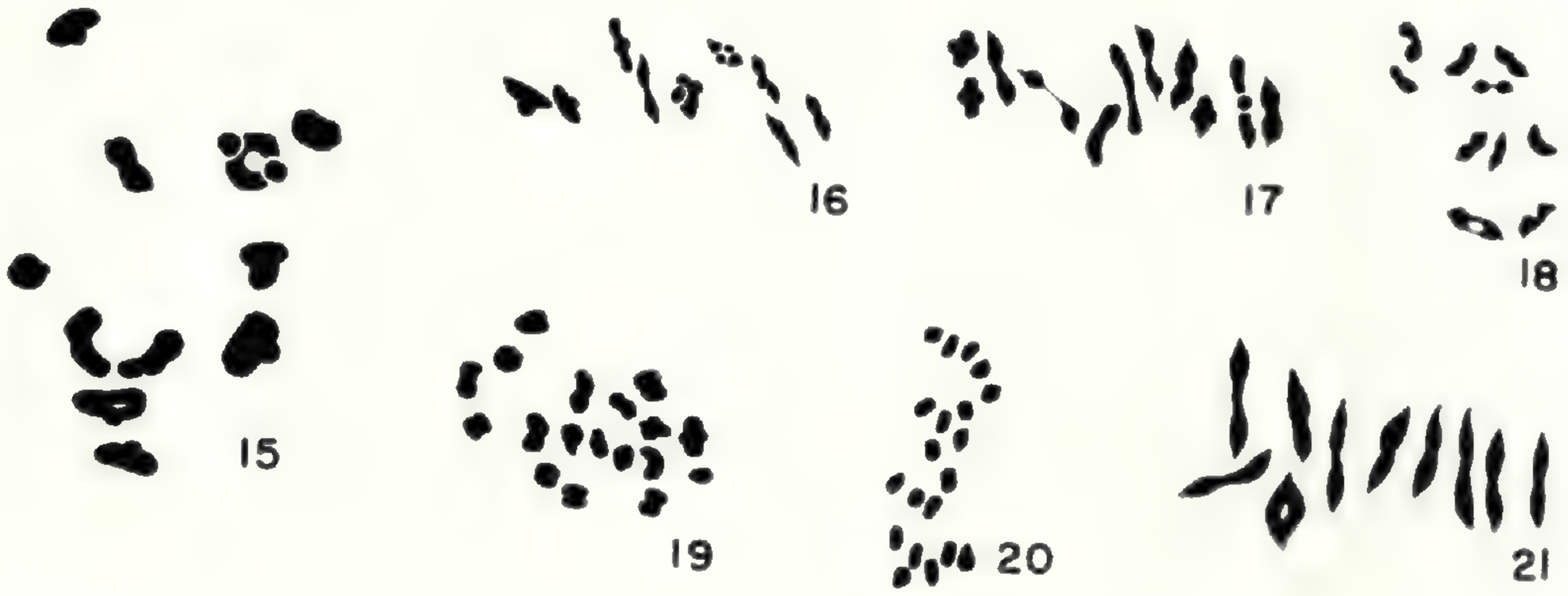
Sphenoclea zeylanica Gaertn.*: **n = 12**. Texas. Nacogdoches Co., Angelina River and Hwy. 59, *Oliver 357* (SMU, TEX). Determined by Dr. L. H. Shinners.

COMPOSITAE

Cirsium horridulum Michx.*: (1) **2n = 34**, fig. 52. Florida. Franklin Co., near Alligator Point, *Godfrey 59335* (FSU); 2 plants studied. (2) **2n = 34**. Florida. Leon Co., 21 miles SW of Tallahassee, *Stripling 697* (FSU); 2 plants studied.

Elephantopus carolinianus Raeusch.: **n = 11**. Texas. Nacogdoches Co., Angelina River and Hwy. 21, *Ross 72* (SMU, TEX). Verification of Baldwin & Speese (1955) as $2n = 22$.

FIG. 15-38. Chromosomes of angiosperms. × 1350. Fig. 15. *Apios americana, Redus 15*, $n = 11$; fig. 16. *Centrosema virginianum, Redus 1*, $n = 9$; fig. 17. *Desmodium canescens, Redus 9*, $n = 11$; fig. 18. *Galactia macreei, Redus 6*, $n = 10$; fig. 19. *Cnidoscolus texanus, Ross 66*, $n = 18$; fig. 20. *Croton capitatus, Lewis 4994*, $2n = 20$; fig. 21. *Cliftonia monosepala, Stripling 1007*, $n = 10$; fig. 22. *Hypericum* sp., *Adams & Tyson 833*, $n = 9$; fig. 23. *H. microsepalum, Stripling 772*, $n = 9$; fig. 24. *Viola walteri, Lacey 3*, $2n = 20$; fig. 25. *Piriqueta glabrescens, Osborne 62*, $n = 7$ (6 II + 2 I); fig. 26. *P. tomentosa, Osborne 66*, $n = 7$; fig. 27. *Rotala ramosior, Lewis & Oliver 5273*, $n = 16$; fig. 28. *Samolus parviflorus, Oliver 261*, $n = 13$; fig. 29. *Halesia diptera* var. *diptera, Stripling 732*, $2n = 24$; fig. 30. *H. diptera* var. *magniflora, Stripling 730*, $2n = 24$; fig. 31. *H. tetraptera, Stripling 716*, $2n = 24$; fig. 32. *Menodora scabra, Ross 52*, $n = 11$ (1 side anaphase I); fig. 33. *Sabatia campestris, Lewis 5494*, $n = 13$; fig. 34. *Bonamia humistrata, Lewis & Oliver 5318*, $n = 14$; fig. 35. *B. pickeringii, Lewis & Oliver 5279*, $n = 14$; fig. 36. *Salvia reflexa, Lewis 5750*, $n = 10$; fig. 37. *Scutellaria* cf. *integrifolia, Stripling 754*, $2n = 32$; fig. 38. *Stachys tenuifolia, Ross 56*, $n = 16$.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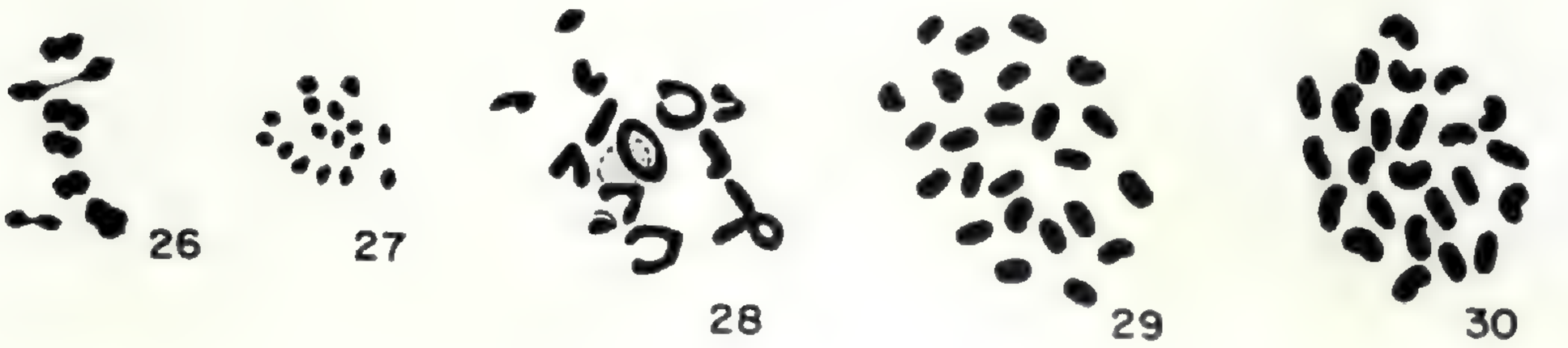
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Liatris acidota Engelm. & Gray: **n = 10.** Texas. Liberty Co., 4 miles E of Cleveland, *Ross 76* (SMU, TEX). Verification of Gaiser (1949).

Perityle sp.*: **n = 19.** MEXICO. Baja California Sur. 14 km. N of La Paz, *Lewis 5351* (SMU).

P. palmeri Wats.*: **n = 19,** fig. 53. MEXICO. Sonora. 2.8 miles N of Guaymas, *Lewis 5334* (SMU).

Silphium asperrimum Hook.*: (1) **n = 8, 2n = 16,** fig. 54. Texas. Smith Co., 1 mile N of Bullard, *Stripling 510* (FSU); 2 plants studied. (2) **2n = 16.** Texas. Nacogdoches Co., 3 miles S of Nacogdoches, *Stripling 586* (FSU).

S. compositum Michx.*: **n = 7, 2n = 14,** fig. 55. Florida. Lafayette Co., between Fletcher and Cross City along Hwy. 351, *Stripling 798* (FSU); 3 plants studied. — STEPHEN F. AUSTIN STATE COLLEGE, NACOGDOCHES, TEXAS, AND FLORIDA STATE UNIVERSITY, TALLAHASSEE.

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FIGS. 39-55. Chromosomes of angiosperms, X 1350. Fig. 39. *Bacopa monnieri, Lewis 5497*, $2n = 64$; fig. 40. *Gratiola ramosa, Stripling 734*, $2n = 14$; fig. 41. *G. aurea, Adams 588*, $2n = 28$; fig. 42. *G. brevifolia, Stripling 794*, $n = 14$; fig. 43. *G. virginiana, Stripling 705*, $2n = 16$; fig. 44. *Lindernia dubia, Lewis et al.* 5500, $n = 16$; fig. 45. *Scoparia dulcis, Ross 62*, $n = 10$; fig. 46. *Tragiola pilosa, Stripling 883*, $2n = 22$; fig. 47. *Veronica persica, Stripling 788*, $2n = 28$; fig. 48. *Utricularia inflata, Godfrey 59374*, $n = 9$; fig. 49. *U. inflata, Reinert 2*, $2n = 36$; fig. 50, *Justicia lanceolata, Lewis & Oliver 5320*, $n = 14$; fig. 51. *J. lanceolata, Lewis & Oliver 5311*, $n = 14 + 1$ (14 II + 1 I); fig. 52. *Cirsium horridulum, Godfrey 59335*, $2n = 34$; fig. 53. *Perityle* sp., *Lewis 5351*, $n = 19$; fig. 54. *Silphium asperrimum, Stripling 510*, $2n = 16$; fig. 55. *S. compositum, Stripling 798*, $n = 7$.

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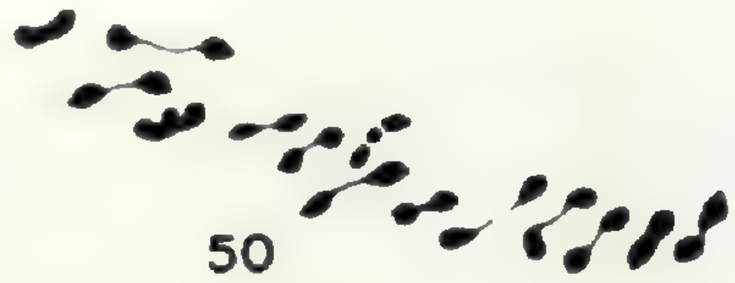

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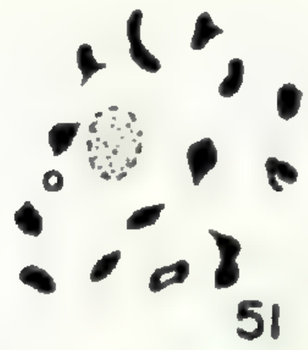

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GLANDULARITY IN RUBUS ALLEGHENIENSIS PORTER[1]

A. R. HODGDON AND FREDERIC STEELE

For the past 4 years we have been studying the blackberries of New Hampshire and nearby parts of Maine and Vermont. This was started as a floristic study to determine what taxa occur in New Hampshire and where in the State each is found.

Fernald (1) quoted in part here, has the following to say about the classification of *Rubus* Subgenus *Eubatus* which embraces the Blackberries, "Taxonomically a most difficult group. Our few original wide-ranging, essentially unvarying and ancient species have greatly commingled producing sometimes localized but rapidly spreading offspring . . ." We have assumed as Fernald apparently did from what he stated farther on in this long footnote, that certain of the multitude of species that have been described are of a different order taxonomically from the others.

One of our primary objectives has been to determine which of our species in New Hampshire may be characterized as well-marked. Unquestionably one of the most clearly defined is the one in question here, *Rubus allegheniensis.* It has an extensive range and possesses some taxonomic characters that are recognized readily in the majority of specimens though considerable diversity is displayed in some

[1]Published with approval of the Director of the New Hampshire Agricultural Experiment Station as Scientific Contribution No. 290.

of its features. We have come to be suspicious of the terms "unvarying" or "essentially unvarying" as applied to any wide ranging species of blackberry known to us. A study based on populations more than on individuals seems to lead inevitably to a broader and more inclusive interpretation of the well established taxa in *Rubus*. Since many of the less well-marked species are characterized by features that seem to us to fall within the proper limits of variation of the better defined ones we suggest that eventually there should be a marked reduction in the number of accepted species in the Subgenus *Eubatus*.

This paper presents evidence to show that *Rubus allegheniensis* has been interpreted too narrowly in respect to its glandularity. This should make it possible for more effective use to be made of Fernald's key to the Section *Alleghenienses* (2) by changing some of the statements there. At present, with many specimens, the key is quite unworkable if followed literally, and therefore, in our opinion, needs to be corrected. The first major division of the key is concerned with glandularity of the primocanes. We note the following statements, "axis of primocane (except sometimes at expanding tip) without or essentially without stipitate glands on the internodes or among the prickles" contrasted to "axis of primocane bearing several to very many long stipitate glands among the prickles." Four New England species thus are distinguished from *R. allegheniensis* by having glandular primocanes. Of these only one, *R. ravus* Bailey, is stated in the key to have long cylindric racemes of flowers, in this respect resembling *R. allegheniensis*. In using the key let us assume that a specimen is found to occur in the Section *Alleghenienses;* if it has evident glands on the mature primocanes and in addition has its flowers in well-developed racemes, the specimen will be identified in the key as *R. ravus* rather than *R. allegheniensis*. One would also have trouble getting by the first statement in the key in L. H. Bailey's treatment of Rubus (3) which, in part at least, seems to have served as a model for the key in Gray's Manual.

For many years we have been confused by these keys, a major difficulty being that much material, at least in Northern and Central New England, has glands on the mature primocanes and yet in other ways fits *R. allegheniensis*. *R. ravus* is an excessively prickly and glandular taxon of localized occurrence. We don't at present have convincing evidence that it is a good species. In herbaria it is represented from only a few localities but recent field observations and collections by us indicate it to be of occasional occurrence, though it may be widespread. The material to be discussed below resembles *R. ravus* only in having glands on the primocanes and by having more or less elongated racemes. Except for the glandular primocanes, there would certainly be no hesitancy about calling all of these specimens *R. allegheniensis*.

In 1953 the junior author made some observations of a colony of *R. allegheniensis* in Sandwich, New Hampshire. In the middle of June it was noted that all of the primocanes in the colony, which had not then reached full growth, were heavily glandular. Collections made from the colony at weekly intervals indicated that the glands tended to disappear as the canes matured. A rather dense pubescence remained on the primocanes of this particular colony. Since 1951 the senior author frequently has collected specimens which have the characteristics of *R. allegheniensis* except that they have noticeable glands on the primocanes. At first he was inclined to call these *R. ravus* but glandular plants occurred so often and these had such varying numbers of glands that a very different explanation was suggested. These observations thus impelled us to undertake a systematic study of gland-occurrence on the primocanes of *R. allegheniensis*.

Collections of 10 primocanes were made from each of 9 colonies in different localities in New Hampshire and from one in southern Maine between the dates of July 15 and November 11, 1959. These colonies were selected entirely without regard for glandularity. The colonies were all vigorous, consisting of well-grown primocanes and flori-

canes intermixed. Since the canes in each colony grew in close proximity, it was thought that in many of the colonies the canes were genetically similar, having arisen from the same single rootstock. Sections about 30 cm. long were collected; these were taken from about the middle of full-sized primocanes. The attempt was made to distribute the collecting somewhat uniformly throughout each colony. The stands ranged in size from 20 or 30 square metres down to stands that barely yielded 10 primocanes for our study.

The results of counts of glands are shown in Fig. 1; 35% of the plants fell in the class of less than 100 glands per decimeter and therefore, compared with heavily glandular stems, might be considered as essentially without glands though it is to be noted that they are still fairly obvious under 10X magnification down to fewer than 50 per decimeter. The matter of glandularity then can become important subjectively, depending on the diligence with which one searches for glands, also the quality of lens used and the interpretation of what is meant by the phrase "essentially without glands." Assuming that any condition fewer than 100 glands per decimeter may fit the requirement of *R. allegheniensis* of relative glandlessness, we were left with 65% of the canes, including at least 2 from each colony and all of them from one, which had more than 100 glands per decimeter — certainly enough to notice and to create doubt and confusion when trying to use the key. In 7 of the colonies one or more canes had more than 500 glands per decimeter, a situation which could hardly be ignored by any critical observer. Of considerable interest is the variation in glandularity within any particular colony. Some of the colonies almost certainly were from common rootstocks. Yet all displayed some differences between canes and 6 of the colonies had markedly different numbers of glands on most of their canes. Many questions and unsolved problems are suggested by these data.

Because of some of the questions raised in this study, a canvass was made of readily available herbarium specimens to find out if the results noted in New Hampshire and

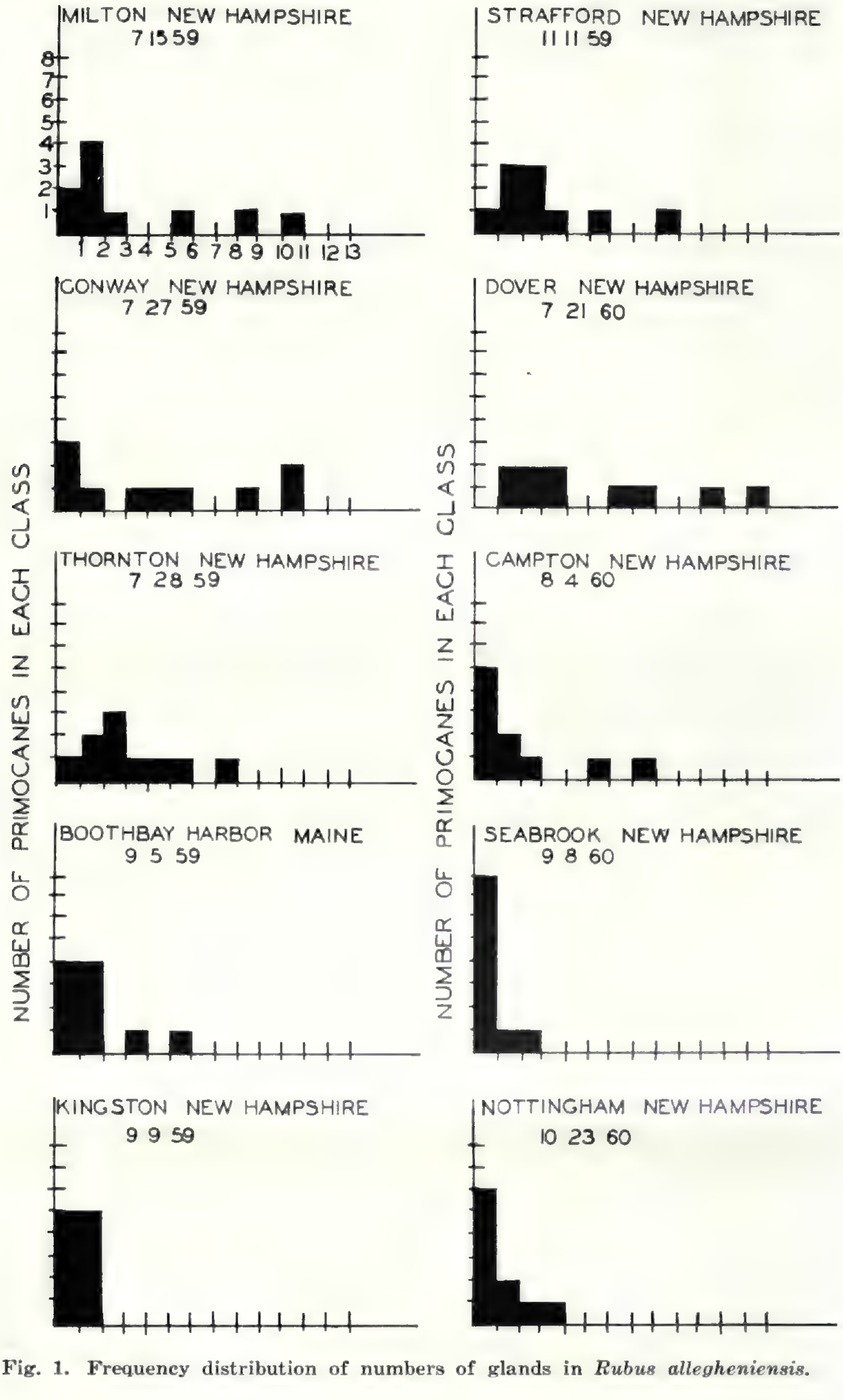

Fig. 1. Frequency distribution of numbers of glands in *Rubus allegheniensis*.

southern Maine might be expected elsewhere in the range of the species. Unfortunately, many herbarium specimens of blackberries are quite useless for critical study, lacking either floricanes or primocanes and often without growth-habit notes. In addition, young primocanes collected at the time of flowering tend to give an unfair impression of glandularity. Nonetheless a sufficient number of good specimens were available in the Gray Herbarium and the herbarium of the New England Botanical Club, as well as the University of New Hampshire collection and the private collection of the junior author to give us a more general picture. Table 1 summarizes the data on primocane glands as best it could be determined from the aforementioned herbaria. From outside of New England and particularly from the southern parts of the range the specimens available were few and mostly inadequate in that frequently they lacked good primocanes. Similar field and herbarium studies of *R. allegheniensis* should be carried out in areas other than New England to provide a more complete analysis of glandularity in this species. A glance at some specimens from the Maritime Provinces of Canada indicated that we might expect to find considerable glandularity there.

Table 1. — Glandularity in Herbarium Material of *R. allegheniensis*

Location	Numbers of primocanes in classes based on number of glands per decimeter.					
	0-99	100-199	200-299	300-399	400-499	more than 500
Maine	11	3	2	0	1	5
New Hampshire	38	10	6	8	5	10
Other New England States	5	5	–	4	2	3
States other than New England	21	2	2	1	3	1

From the table we see that slightly more than half of the primocanes are relatively glandless with fewer than 100 glands per decimeter, this being considerably more than in our population samples. It is evident however that, in most parts of the range, there would be specimens to cause perplexity and confusion when using the key. In states other

than New England most of the heavily glandular specimens came from the northern tier of states. If diminished glandularity is partly a function of development, it might be that the longer growing period of the more southern parts of the range may contribute to a reduction in glands. Though not shown in the table, entirely glandless specimens constituted only a minor proportion of the primocanes in herbarium specimens.

The var. *neoscoticus* Fernald of *Rubus allegheniensis* is interpreted by Bailey (4) as being glandular, though this character is ignored in Fernald's handling of it in Gray's Manual. Our glandular specimens definitely do not fit this variety.

In the Harvard Herbarium an examination was made of sheets of the supposedly glandular species of Section *Alleghenienses* including *R. ravus* Bailey, *R. glandicaulis* Blanch., *R. frondisentis* Blanch. and *R. sceleratus* Brainerd. The typical plants of these were not only heavily glandular with 1,500 or, more frequently, 2 or 3,000 or more glands per decimeter but differed also in character of armature, the prickles in some cases being thin and acicular and in others broad-based but very abundant.

Bailey in Gentes Herbarium makes a more satisfactory separation of *R. ravus* and the other very glandular species than does Fernald in that he takes the accompanying armature into consideration. As a substitute for the primary divisions of the key to the Section *Alleghenienses* (2), we suggest that the following be used:

Mature primocanes with none or few glands or only moderately glandular (0-1200 per dm.) along with few to many stiff broad-based prickles.

Mature primocanes with numerous glands (1500-5000 per dm.) along with many bristles or slender prickles or exceptionally broad-based prickles, the prickles if broad-based, abundant and almost contiguous.

Many of the taxa in the very glandular group appear to be hybrids with an admixture of *R. setosus* or to show introgression with that species.

Specimens of primocane and voucher material used in the population studies have been placed in the University of New Hampshire Herbarium.

The authors wish to thank the curators of the Harvard Herbarium and the New England Botanical Club Herbarium for their permission to consult these collections freely.
— DEPARTMENT OF BOTANY, UNIVERSITY OF NEW HAMPSHIRE, DURHAM, NEW HAMPSHIRE AND ST. MARY'S-IN-THE-MOUNTAINS, LITTLETON, NEW HAMPSHIRE.

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2. ———————. 1950. Gray's Manual, 8th edition (footnote on p. 853).
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4. ———————. 1944. Gent. Herb. V. 509.

FIFTEENTH REPORT OF THE COMMITTEE ON PLANT DISTRIBUTION

The fourteenth report included the Dicotyledoneae from Papaveraceae through Platanaceae. The present report deals with the genus Carex of the Cyperaceae.

The data for these reports have been compiled from the material found in the herbarium of the New England Botanical Club, in the Gray Herbarium, and in the herbarium of the Peabody Museum at Salem.

Preliminary Lists of New England Plants — XL

The sign + indicates that an herbarium specimen has been seen, the sign — that a reliable printed record has been found and the sign * is used for those plants which are not native in the New England area.

CYPERACEAE

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.
Carex abdita Bickn.	+	+	+	+	+	+
Carex abscondita Mackenz.		+		+	+	+
*Carex acutiformis Ehrh.				+		

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.
Carex adusta Boott	+					
Carex aenea Fern.	+	+	+	+		+
Carex aestivalis M. A. Curtis		+	+	+		+
Carex alata T. & G.				+	+	
Carex albolutescens Schwein.		+		+	+	
Carex albursina Sheldon		+	+	+		+
Carex alopecoidea Tuckerm.	+		+	+		+
Carex amphibola Steud. var. rigida (Bailey) Fern.		+		+		+
Carex amphibola var. turgida Fern.	+	+	+	+		+
Carex angustior Mackenz.	+	+	+	+	+	+
Carex annectens Bickn.	+	+	+	+	+	+
Carex annectens var. xanthocarpa (Bickn.) Wieg.		+	—	+		+
Carex aquatilis Wahlenb. var. altior (Rydb.) Fern.	+		+	+		+
Carex arcta Boott	+	+	+	—		
Carex arctata Boott	+	+	+	+	+	+
Carex argyrantha Tuckerm.	+	+	+	+	+	+
Carex artitecta Meckenz.	+	+	+	+	+	+
Carex artitecta var. subtilirostris F. J. Herm.				+		
Carex atherodes Spreng.	+					
Carex atlantica Bailey	+	+	+	+		+
Carex atratiformis Britt.	+	+	+			
Carex aurea Nutt.	+	+	+	+	—	+
Carex Backii Boott	+	+	+	+		
Carex Baileyi Britt.		+	+	+		
Carex Barrattii Schwein. & Torr.						+
Carex Bebbii Olney	+	+	+	+		+
Carex Bicknellii Britt.	+	+	+	+	+	+
Carex Bigelowii Torr.	+	+	+			
Carex blanda Dew.		+	+	+	+	+
Carex brevior (Dew.) Mackenz.	+	+	+	+	+	+
Carex bromoides Schkuhr.	+	+	+	+	+	+
*Carex brunnea Thunb.				+		
Carex brunnescens (Pers.) Poir.	+	+	+			
Carex brunnescens var. sphaerostachya (Tuckerm.) Kükenth.	+	+	+	+		+
Carex bullata Schkuhr.	+	+	—	+	+	+
Carex Bushii Mackenz.						+
Carex Buxbaumii Wahlenb.	+	+	+	+	+	+
Carex canescens L.	+	+	+			
Carex canescens var. disjuncta Fern.	+	+	+	+	+	+
Carex canescens var. subloliacea Laestad.	+	+	+	+	+	+
Carex capillaris L.		+				
Carex capillaris var. major Blytt	+		+			
Carex capitata L.		+				
*Carex caryophyllea Lat.	+			+		
Carex castanea Wahlenb.	+	+	+			+
Carex cephalantha (Bailey) Bickn.	+	+	+	+	+	+
Carex cephaloidea Dew.	+	+	+	+	—	+
Carex cephalophora Muhl.	+	+	+	+	+	+
Carex chordorrhiza L.f.	+		+			
Carex Collinsii Nutt.					+	+
Carex communis Bailey	+	+	+	+	+	+

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.
Carex comosa Boott	+	+	+	+	+	+
Carex conoidea Schkuhr.	+	+	+	+	+	+
Carex convoluta Mackenz.	+	+	+	+	+	+
Carex × copulata (Bailey) Mackenz.		+	+	+		+
Carex Crawei Dew.	+					+
Carex Crawfordii Fern.	+	+	+	+		+
Carex crinita Lam.	+	+	+	+	+	+
Carex crinita var. brevicrinis Fern.				+	+	+
Carex crinita var. gynandra (Schwein.) Schwein. & Torr.	+	+	+	+	+	+
Carex crinita var. minor Boott	+	+	+	+		
Carex crinita var. Porteri (Olney) Fern.	+		+			
Carex crinita var. simulans Fern.	+	+	+	+		
Carex cristatella Britt.		+	+	+		+
Carex cumulata (Bailey) Mackenz.	+	+		+		+
Carex Davisii Schwein. & Torr.			+	+		+
Carex debilis Michx.	+		—			
Carex debilis var. interjecta Bailey		+	+	+		+
Carex debilis var. Rudgei Bailey	+	+	+	+	+	+
Carex debilis var. strictior Bailey	+	+	+	+		
Carex deflexa Hornem.	+	+	+	+		
Carex demissa Hornem.	+	+	+			+
Carex Deweyana Schwein.	+	+	+	+	—	+
Carex diandra Schrank	+	+	+	+		+
Carex digitalis Willd.	+	+	+	+	+	+
Carex disperma Dew.	+	+	+	+		+
Carex eburnea Boott			+	+		+
Carex elachycarpa Fern.	+					
Carex Emmonsii Dew.	+	+	+	+	+	+
Carex exilis Dew.	+	+	+	+	+	
Carex festucacea Schkuhr.				+		+
Carex flaccosperma Dew. var. glaucodea (Tuckerm.) Kükenth.		+	—	+		+
Carex flava L.	+	+	+	+		+
Carex flava var. fertilis Peck	+	+	+	+	+	+
Carex flava var. gaspensis Fern.	+		+			
Carex foenea Willd.	+	+	+	+	+	+
Carex folliculata L.	+	+	+	+	+	+
Carex formosa Dew.		—	+	+		+
Carex Garberi Fern. var. bifaria Fern.	+					
Carex gracilescens Steud.		+	+	+		+
Carex gracillima Schwein.	+	+	+	+	+	+
Carex granularis Muhl.			+	+		+
Carex granularis var. Haleana (Olney) Porter	+	+	+	+		+
Carex Grayii Carey			+	+		+
Carex Grayii var. hispidula Gray						+
Carex gynocrates Wormsk.	+					
Carex × Hartii Dew.	+	+	+	+		
Carex Haydenii Dew.	+	+	+	+		+
Carex hirsutella Mackenz.			+	+	—	+
*Carex hirta L.	+			+		
Carex hirtifolia Mackenz.	+	+	+	+	—	+
Carex Hitchcockiana Dew.			+	+		+
Carex hormathodes Fern.	+	+		+	+	+
Carex hormathodes × straminea				+		

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.
Carex Houghtonii Torr.	+	+	+			
Carex Howei Mackenz.	+	+	+	+	+	+
Carex hystricina Muhl.	+	+	+	+	—	+
Carex incomperta Bickn.	+	+		+	+	+
Carex interior Bailey	+	+	+	+	+	+
Carex intumescens Rudge	+	+	+	+	+	+
Carex intumescens var. Fernaldii Bailey	+	+	+	+		+
Carex Josselynii (Fern.) Mackenz.	+					
Carex katahdinensis Fern.	+					
Carex × Knieskernii Dew.	+	+	+	+		
Carex lacustris Willd.	+	+	+	+	+	+
Carex laevivaginata (Kükenth.) Mackenz.	+	+	+	+	+	+
Carex lanuginosa Michx.	+	+	+	+	+	+
Carex lasiocarpa Ehrh. var. americana Fern.	+	+	+	+	+	+
Carex laxiculmis Schwein.	+	+	+	+	+	+
Carex laxiflora Lam.	+	+	+	+	+	+
Carex lenticularis Michx.	+	+	+	+		
Carex lenticularis var. albi-montana Dew.		+				
Carex lenticularis var. Blakei Dew.	+	+	+	+		
*Carex leporina L.	+	+		+		
Carex leptalea Wahlenb.	+	+	+	+	+	+
Carex leptonervia Fern.	+	+	+	+		+
Carex limosa L.	+	+	+	+		+
Carex livida (Wahlenb.) Willd. var. Grayana (Dew.) Fern.	+		+	+		—
Carex Longii Mackenz.	+			+	+	+
Carex lupuliformis Sartwell			+			+
Carex lupulina Muhl.	+	+	+	+	+	+
Carex lupulina var. pedunculata Gray	+	+	+	+	+	+
Carex lurida Wahelenb.	+	+	+	+	+	+
Carex Mackenziei Krecz.	+					
Carex mainensis Porter	+					
Carex Merritt-Fernaldii Mackenz.	+	+	+	+	+	+
Carex mesochorea Mackenz.				—		
Carex Michauxiana Boeckl.	+	+	+	+		
Carex Mitchelliana M. A. Curtis				+	+	
Carex molesta Mackenz.			+	+		+
Carex Muhlenbergii Schkuhr	+	+	+	+	+	+
Carex Muhlenbergii var. enervis Boott		+	+	+	+	+
Carex nigra (L.) Reichard	+	+	—	+	+	
Carex nigra var. strictiformis (Bailey) Fern.	+	+		+		
Carex nigromarginata Schwein.						+
Carex normalis Mackenz.	+	+	+	+	+	+
Carex novae-angliae Schwein.	+	+	+	+		+
Carex oligocarpa Schkuhr			+	+		+
Carex oligosperma Michx.	+	+	+	+		+
Carex × Olneyi Boott		+		+	+	+
Carex ormostachya Wieg.	+	+	+	+		+
Carex oronensis Fern.	+					
Carex paleacea Wahlenb.	+	+		+		
Carex pallescens L. var. neogaea Fern.	+	+	+	+	+	+
*Carex panicea L.	+	+		+	+	+
Carex pauciflora Lightf.	+	+	+	+		+
Carex paupercula Michx.	+	+	+	+		
Carex paupercula var. irrigua (Wahlenb.) Fern.	+	+	+	+		+

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.
Carex paupercula var. pallens Fern.	+	+	+	+		+
Carex Peckii Howe	+	+	+	+		
Carex pedunculata Muhl.	+	+	+	+		+
Carex pensylvanica Lam.	+	+	+	+	+	+
Carex pensylvanica var. distans Peck	+	+	+	+	+	+
Carex plantaginea Lam.	+	+	+	+		+
Carex platyphylla Carey	+	+	+	+	+	+
Carex polymorpha Muhl.	+	+		+	+	+
Carex prairea Dew.	+		+	+		+
Carex prasina Wahlenb.	+	+	+	+		+
Carex praticola Rydb.	+					
Carex projecta Mackenz.	+	+	+	+		+
Carex Pseudo-Cyperus L.	+	+	+	+		+
Carex × pseudohelvola Kihlm.	+					
Carex radiata (Wahlenb.) Dew.	+	+	+	+		+
Carex rariflora (Wahlenb.) Sm.	+					
Carex retroflexa Muhl.			—	+	+	+
Carex retrorsa Schwein.	+	+	+	+		+
Carex Richardsonii R. Br.			+			
Carex rosea Schkuhr	+	+	+	+		+
Carex rostrata Stokes	+	+	+	+	+	+
Carex rostrata var. ambigens Fern.	+			+		
Carex rostrata var. utriculata (Boott) Bailey	+	+	+	+	+	+
Carex salina Wahlenb. var. kattegatensis (Fries) Almq.	+	+		+		
Carex salina × stricta				+		
Carex saxatilis L. var. miliaris (Michx.) Bailey	+					
Carex saxatilis var. rhomalea Fern.	+					
Carex scabrata Schwein.	+	+	+	+	+	+
Carex scirpoidea Michx.	+	+	+			
Carex Schweinitzii Dew.			+	+		+
Carex scoparia Schkuhr	+	+	+	+	+	+
Carex scoparia var. tesselata Fern. & Wieg.	+					
Carex seorsa Howe				+	+	+
Carex × setacea Dew.			+	+		+
Carex silicea Olney	+	+		+	+	+
Carex sparganioides Muhl.	—	+	+	+		+
*Carex spicata Huds.	+	+		+	+	+
Carex Sprengelii Dew.	+	+	+	+		+
Carex squarrosa L.				+	+	+
Carex sterilis Willd.	+			+		+
Carex stipata Muhl.	+	+	+	+	+	+
Carex straminea Willd.				+		+
Carex striatula Michx.				+		+
Carex stricta Lam.	+	+	+	+	+	+
Carex stricta var. strictior (Dew.) Carey	+	+	+	+	+	+
Carex styloflexa Buckl.						+
Carex Swanii (Fern.) Mackenz.	+	+	+	+	+	+
Carex tenera Dew.	+	+	+	+	+	+
Carex tenera var. echinodes (Fern.) Wieg.			—			+
Carex tenuiflora Wahlenb.	+		+	—		
Carex tetanica Schkuhr				+		+
Carex tincta Fern.	+	+	+	+		+
Carex tonsa (Fern.) Bickn.	+	+	+	+	+	+

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.
Carex torta Boott	+	+	+	+	—	+
Carex tribuloides Wahlenb.	+	+	+	+	+	+
Carex × trichina Fern.	+					
Carex trichocarpa Muhl.			+	+		+
Carex trisperma Dew.	+	+	+	+	+	+
Carex trisperma var. Billingsii Knight	+	+	+	+	+	+
Carex Tuckermani Boott	+	+	+	+	—	+
Carex typhina Michx.	+		+	+		+
Carex umbellata Schkuhr	+	+	+	+	+	+
Carex vaginata Tausch	+		+			
Carex vesicaria L.	+	+	+	+	+	+
Carex vesicaria var. distenta Fries	+		+			+
Carex vesicaria var. jejuna Fern.	+	+	+	+	+	+
Carex vesicaria var. monile (Tuckerm.) Fern.	+	+	+	+	+	+
Carex vesicaria var. Raeana (Boott) Fern.	+	+				
Carex vestita Willd.	+	+		+	+	+
Carex virescens Muhl.	+	+	+	+	+	+
Carex viridula Michx.	+	+	+	+	+	+
Carex vulpinoidea Michx.	+	+	+	+	+	+
Carex Walteriana Bailey var. brevis Bailey				+	—	
Carex Wiegandii Mackenz.	+		+	+		
Carex Willdenowii Schkuhr			+	+		+
Carex Woodii Dew.				—		+

Carex was treated by Prof. M. L. Fernald in Rhodora 4:218-230. Since then the number of specimens available for study has become very much larger and also there has been a considerable change in nomenclature. It consequently seemed desirable to reevaluate the genus in the light of the more abundant material. At the conclusion of his report Prof. Fernald added "Suggestions for Special Observations". It is interesting to note that in at least half the species cited, the extension of range that he anticipated has been confirmed.

In contrast to the previous reports the number of introduced species is insignificant. There are only seven in our New England area and of these, two were not included in Prof. Fernald's list.

The geographical areas are in general the same as in the previous reports.

I. GENERALLY DISTRIBUTED. — *Carex angustior, C. canescens* var. *disjuncta* and var. *subloliacea, C. cephalantha, C. crinita* and var. *gynandra, C. debilis* var. *Rudgei, C. intumescens, C. lasiocarpa* var. *americana, C. leptalea, C. limosa, C. pallescens* var. *neogaea, C. rostrata* and var. *utriculata, C. stipata, C. striata, C. tenera, C. trisperma* and var. *Billingsii, C. vulpinoidea.*

Carex limosa apparently is absent from southern New Hampshire, southern Connecticut and all of Rhode Island. *C. tenera* is largely absent from Aroostook County, Maine with only one station at Fort Fairfield, is represented by only one specimen each in Plymouth County at Bridgewater and in Barnstable County at Provincetown, and is absent from Rhode Island.

Ia. GENERAL, EXCEPT CAPE COD. — *Carex arctata, C. bromoides, C. brunnescens* var. *sphaerostachya, C. communis, C. conoidea, C. Deweyana, C. disperma, C. flava* and var. *fertilis, C. Haydenii, C. hystricina, C. lacustris, C. leptonervia, C. pedunculata, C. projecta, C. scabrata, C. tribuloides, C. vesicaria* and vars. *monile* and *jejuna.*

Carex bromoides is infrequent north of 45°. *C. brunnescens* var. *sphaerostachya* is not yet known from Rhode Island or southern Connecticut. *C. conoidea* has not been found on Nantucket. *C. Deweyana* has not yet been reported from Rhode Island or southern Connecticut and only two stations are known in eastern Massachusetts. *C. flava, C. hystricina, C. pedunculata* and *C. projecta* are absent from Plymouth and Bristol counties in Massachusetts and from Rhode Island. *C. scabrata* belongs in this category except for a single specimen from Sandwich, Massachusetts. *C. tribuloides* occurs on Cape Cod but only at Woods Hole and Falmouth, Massachusetts.

Ib. GENERAL, EXCEPT CAPE COD AND THE MAINE COAST EAST OF THE KENNEBEC RIVER. — *Carex torta* belongs here but it seems to avoid all the coast from the Quinnipiack River in Connecticut northeastward.

Ic. GENERAL, EXCEPT CAPE COD AND WASHINGTON COUNTY, MAINE. — *Carex abdita, C. convoluta, C. Buxbaumii, C. gracillima, C. interior, C. stricta* var *strictior.* Although absent from Cape Cod there is a specimen of *C. abdita* from Martha's Vineyard. *C. convoluta* is rare north of 45°. *C. Buxbaumii* is a rather uncommon species with only one station in New Hampshire at Columbia in Coos County, and three in Vermont. In southern New England it seems to be concentrated west and north of Boston. There is one specimen of *C. interior* from Nantucket. *Carex stricta* var. *strictior,* although a rich woods species, is represented by two specimens from Martha's Vineyard annotated by K. K. Mackenzie.

IIa. NORTHERN — NOT OR NOT MUCH SOUTH OF 43°. — *Carex aenea, C. arcta, C. atratiformis, C. Backii, C. canescens, C. crinita* var. *minor* and var. *simulans, C. demissa, C. gynocrates, C. Houghtonii, C. lenticularis* and var. *Blakei, C. Michauxiana, C. paupercula* and var. *irrigua, C. Peckii, C. scirpoidea, C. tenuiflora, C. vesicaria* var. *Raeana, C. Wiegandii. C. atratiformis* is infrequent and chiefly calcicolous. Although *C. Backii* is a northern species it is not represented by any specimen north of 45°. *C. demissa* is adventive along the coast in southern Connecticut. *C. gynocrates* apparently is restricted to the calcareous areas of northern Maine with no station south of 45°.

C. scirpoidea is found chiefly in mountainous areas. *C. tenuiflora* is apparently a species of basic soils and is rare in New England.

IIb. NORTHERN — NUMEROUS STATIONS SOUTH OF 43°. — *Carex Crawfordii, C. deflexa, C. intumescens* var. *Fernaldii, C. novae-angliae, C. oligosperma, C. ormostachya, C. pauciflora, C. paupercula* var. *pallens, C. Pseudo-Cyperus, C. retrorsa, C. tincta. C. intumescens* var. *Fernaldii* is absent from Rhode Island and is known from a single station, Colebrook, in northwestern Connecticut. *C. ormostachya* and *C. tincta* have their southernmost stations chiefly in western Massachusetts. *C. pauciflora,* south of 43°, occurs at several stations in western Massachusetts and at one in Norfolk in northwestern Connecticut. *C. retrorsa,* south of 43°, is confined to and is frequent in western New England.

III. ARCTIC-ALPINE. — *Carex Bigelowii, C. brunnescens, C. capillaris, C. capitata, C. lenticularis* var. *albi-montana, C. katahdinensis, C. mainensis, C. rariflora, C. saxatilis* var. *miliaris* and var. *rhomalea. C. Bigelowii* is found on some of the lower mountains in northern New England and thus is not exclusively arctic-alpine.

IVa. SOUTHERN — GENERAL SOUTH OF 45°. — *Carex artitecta, C. comosa, C. cumulata, C. Emmonsii, C. folliculata, C. lupulina, C. lurida, C. Merritt-Fernaldii, C. pensylvanica,* var. *distans, C. scoparia, C. tonsa. C. artitecta* is very sparsely represented in the three northern states. *C. cumulata* is absent from Massachusetts west of the Connecticut River except for stations at Sheffield and Mt. Washington. North of 43° *C. Emmonsii* is entirely coastal except for one station at Burlington, Vermont. *C. tonsa* is very sparsely represented in the three northern states.

IVb. SOUTHERN — GENERAL SOUTH OF 45° BUT NOT ON MAINE COAST EAST OF THE KENNEBEC RIVER. — *Carex annectens* and var. *xanthocarpa, C. blanda, C. Howei. C. annectens* var. *xanthocarpa* is local with only seven stations.

IVc. SOUTHERN — GENERAL SOUTH OF 45° BUT NOT IN WASHINGTON COUNTY. — *Carex atlantica, C. digitalis, C. pensylvanica, C. Swanii, C. umbellata, C. virescens.*

IVd. SOUTHERN — SOUTH OF 45° BUT NOT ON CAPE COD. — *Carex argyrantha.*

IVe. SOUTHERN — GENERAL SOUTH OF 45° BUT NEITHER ON CAPE COD NOR IN WASHINGTON COUNTY.— *Carex brevior, C. cephalophora, C. foenea, C. laxiflora, C. lupulina* var. *pedunculata, C. normalis, C. platyphylla, C. prasina, C. radiata. C. cephalophora* is local north of 43°. *C. lupulina* var. *pedunculata* occurs on both Martha's Vineyard and Nantucket but not on Cape Cod.

V. CHIEFLY THE THREE SOUTHERN STATES. — *Carex incomperta, C. laevigata, C. laxiculmis, C. Muhlenbergii* and var. *enervis, C. vestita. C. Muhlenbergii* has numerous stations in extreme southwestern Maine

and southeastern New Hampshire and two stations in Vermont. *C. Muhlenbergii* var. *enervis* apparently prefers more basic soils.

Va. CHIEFLY THE THREE SOUTHERN STATES BUT NOT IN WESTERN MASSACHUSETTS. — *Carex alata, C. bullata, C. Longii. C. alata* is confined to eastern Massachusetts and Rhode Island.

Vb. CHIEFLY THE THREE SOUTHERN STATES BUT NOT ON CAPE COD. — *Carex aestivalis, C. flaccosperma* var. *glaucodea, C. polymorpha, C. retroflexa, C. seorsa, C. aestivalis* is absent from Rhode Island and is local in northeastern Connecticut.

Vc. CHIEFLY THE THREE SOUTHERN STATES BUT NEITHER CAPE COD NOR WESTERN MASSACHUSETTS. — *Carex abscondita, C. Bicknellii, C. festucacea, C. straminea, C. striatula. C. festucacea* is infrequent. *C. striatula* is local with only six stations.

VI. SOUTHWESTERN NEW ENGLAND CHIEFLY. — *Carex Bushii, C. Davisii, C. nigromarginata.*

VII. WESTERN NEW ENGLAND, CHIEFLY WEST OF THE CONNECTICUT VALLEY. — *Carex Baileyi, C. cristatella, C. gracilescens, C. hirsutella, C. squarrosa. C. Baileyi* is largely confined to Vermont, save for one station at Cheshire in western Massachusetts and one at Franconia, New Hampshire. *C. cristatella* occurs chiefly in western New England but with isolated stations in eastern Massachusetts and New Hampshire. *C. gracilescens* is occasional on basic soils near Boston and occurs at a single station in Coos County and one in Grafton County, New Hampshire. The Boston and Providence stations for *C. squarrosa* doubtless represent waifs.

VIIIa. COASTAL PLAIN PROPER. — *Carex Mitchelliana, C. Walteriana* var. *brevis.*

VIIIb. COASTAL PLAIN EXTENSIONS. — *Carex albolutescens* is a southern coastal plain species that also occurs at Westwood, Massachusetts and at two stations in southeastern New Hampshire.

IXa. CALCICOLOUS — CHIEFLY WEST OF THE CONNECTICUT RIVER IN THE SOUTH, IF IN THE EAST MOSTLY NORTH OF 45°. — *Carex albursina, C. alopecoidea, C. amphibola* var. *rigida* and var. *turgida, C. capillaris* var. *major, C. castanea, C. Crawei, C. eburnea, C. elachycarpa, C. flava* var. *gaspensis, C. formosa, C. Garberi* var. *bifaria, C. granularis, C. Grayii, C. Hitchcockiana, C. Josselynii, C. lupuliformis, C. oligocarpa, C. Schweinitzii, C. tetanica, C. trichocarpa, C. typhina, C. vaginata.*

The majority of these calciphiles occur only in the limestone area of western New England. *C. alopecoidea* has one station at Vassalboro, Kennebec County, Maine. *C. amphibola* var. *turgida* is of more northern distribution than var. *rigida* which has not been reported north of 43° 30″. *C. capillaris* var. *major, C. Garberi* var. *bifaria, C. elachycarpa, C. flava* var. *gaspensis* and *C. Josselynii* are restricted to the calcareous regions of Aroostook County, Maine. *C. castanea* occurs in limy areas in both western and northern New England.

C. Crawei has been reported from only four stations, two in the Aroostook Valley and two in the upper Housatonic Valley in Connecticut. *C. trichocarpa* is absent from most of Vermont. Apparently the only station east of the Connecticut River for *C. typhina* is the one at Leeds, Maine.

IXb. PLANTS OF BASIC SOILS, NOT NECESSARILY LIMESTONES. — *Carex aquatilis* var. *altior, C. aurea, C. Bebbii, C. cephaloidea, C. diandra, C. granularis* var. *Haleana, C. hirtifolia, C. lanuginosa, C. plantaginea, C. prairea, C. rosea, C. sparganioides, C. Sprengellii, C. Tuckermani.* *C. aurea* in our area is not necessarily a cacliphile. *C. Bebbii* is infrequent and is not reported from Rhode Island or eastern Connecticut. *C. cephaloidea, C. hirtifolia* and *C. sparganioides* are rich woods plants not collected north of 45°. *C. plantaginea* is an inland species with no stations on the coast. It is rare north of 45°.

Xa. MARITIME IN VICINITY OF COAST. — *Carex hormathodes, C. Mackenziei, C. paleacea, C. salina* var. *kattegatensis, C. silicea.* A hybrid of *C. hormathodes* and *C. straminea* has been found on Nantucket. *C. Mackenziei* is northern and has not been reported south of York County, Maine. *C. paleacea* is northern extending southward to Plymouth, Massachusetts. *C. salina* var. *kattegatensis* is also northern and is absent south of Boston. A hybrid of *C. salina* var. *kattegatensis* and *C. stricta* is reported from Arlington and Medford, Massachusetts.

Xb. MARITIME WITH INLAND STATIONS. — *Carex nigra* and var. *strictiformis.* The latter has a similar distribution, but is much less common.

XI. MISCELLANEOUS. — *Carex adusta, C. artitecta* var *subtilirostris, C. atheroides, C. Barrattii, C. chordorhiza, C. Collinsii, C.x copulata, C. crinita* var. *brevirostris* and var. *Porteri, C. debilis* and var. *interjecta* and var. *strictior, C. exilis, C. Grayii* var. *hispidula, C.x Hartii, C.x Knieskernii, C. livida* var. *Grayana, C. mesochorea, C. molesta, C.x Olneyi, C. oronensis, C. praticola, C.x pseudohelvola, C. Richardsonii, C. rostrata* var. *ambigens, C. salina x stricta, C. scoparia* var. *tesselata, C.x setacea, C. sterilis, C. tenera* var. *echinoides, C.x trichina, C. vesicaria* var. *distenta, C. viridula, C. Willdenowii, C. Woodii.*

C. adusta occurs only east of the Penobscot River near the coast. *C. artitecta* var. *subtilirostris* has only one station at Malden in eastern Massachusetts. *C. atheroides* has only one station at Rockland, Maine and is possibly a waif. *C. Barrattii* and *C. Collinsii* are southern in distribution reaching their northeastern limit in Connecticut and Rhode Island. *C. chordorrhiza* is a northern species and very local, occurring only in eastern Maine and western Vermont. *C.x copulata* is reported from four stations, Grafton, New Hampshire; Newfane, Vermont; Sandisfield, Massachusetts, and Waterford, Connecticut. *C. crinita* var. *brevirostris* occurs only at Cohasset, Massachusetts; Providence, Rhode Island, and Bridgeport and Danbury, Connecticut.

C. crinita var. *Porteri* has two stations, Monhegan, Maine, and Hancock, Vermont. *C. debilis* has been found on Martha's Vineyard and Nantucket only. *C. debilis* var. *interjecta* has three stations in New Hampshire, one at South Burlington, Vermont, seven in Massachusetts and one in Connecticut. *C. debilis* var. *strictior* has one station in Maine at Brownville, eleven in New Hampshire, one at Willoughby, Vermont and one at Bellingham, Massachusetts. *C. exilis* is concentrated in northeastern Massachusetts but otherwise has only widely scattered stations. *C. Grayii* var. *hispidula* has two stations, Hartford and Middletown, Connecticut. *C.*x *Hartii* has seven scattered stations in New England. *C.*x *Knieskernii* is represented by only five stations in our whole area. *C. livida* var. *Grayana*, a calcicolous species, is placed here as in all New England there are only six stations, two in Aroostook County, Maine, one in western Vermont and three in northeastern Massachusetts. *C. mesochorea* is cited in Gray's Manual from Massachusetts but no specimen has been seen. *C. molesta* has only four stations in New England, Concord, Massachusetts; Ferrisburg, Vermont, and Bethlehem and Southington, Connecticut, *C.*x *Olneyi* has twelve stations in southeastern New England. *C. oronensis* seems to be endemic along the lower Penobscot River in Maine. *C. praticola* is a northern species at its southern limit with two stations only in northern Maine, at Island Falls and Masardis, both in Aroostook County. *C.*x *pseudohelvola* has two stations in extreme southeastern Maine at Moose Island and Pembroke. *C. Richardsonii* is represented by a single station at Mt. Equinox in Manchester, Vermont where it is abundant. *C. rostrata* var. *ambigens* has three stations, at St. Francis, Maine and Monterey and Springfield, Massachusetts. *C. salina* x *stricta* was collected in 1858 at Medford and in 1887 at Arlington in eastern Massachusetts. *C. scoparia* var. *tesselata* has three stations on the Maine coast east of the Penobscot River. *C.*x *setacea* is apparently a hybrid with only four stations in our area. *C. sterilis* has one station at Presque Isle in northeastern Maine and three in Connecticut. *C. tenera* var. *echinoides* has three stations only, one at South Hero, Vermont and two in Connecticut at East Hampton and North Canaan. *C.*x *trichina* has been collected at two stations in the Aroostook Valley, Maine at Chapman and Fort Fairfield. *C. vesicaria* var. *distenta* has only ten widely scattered stations. Perhaps this should be recognized only as a form and not as a good variety. *C. viridula* is placed in this category as it is in part coastal and in part inland chiefly calciphile. Possibly this species requires further study. *C. Willdenowii* has four stations only in New England, one at Sudbury in western Vermont, two at Malden and Randolph in eastern Massachusetts and one at East Haven in southern Connecticut. *C. Woodii* has two stations only at Salisbury and New Milford in extreme western Connecticut.

XII. INTRODUCED SPECIES. — *Carex acutiformis, C. brunnea, C. caryophyllea, C. hirta, C. leporina, C. panicea, C. spicata. C. acutiformis* is reported only from the vicinity of Boston. *C. brunnea* has been collected but once — at Salem, Massachusetts. —

R. C. BEAN, A. F. HILL, R. J. EATON

OCCURRENCE OF SPECIES OF POLYCARPAEA LAM. (CARYOPHYLLACEAE) IN NORTH AMERICA

OLGA LAKELA

Plants unknown to the author were discovered in a marginal area of sandhill off Overlook Drive, adjacent to the business district of Temple Terrace, Tampa, Florida. The plants, reminiscent of *Paronychieae,* were localized in openings of the vegetation, prevailingly of grasses and composites, and a few dwarf live oak. Their compact clusters of silver white cymes in late anthesis and in fruit, gave a touch of luster to the nondescript background. Collection no. 23410 was made October 15, 1960. Subsequently, nos. 24530, August 7, and 24779, October 18, 1961, were collected from the same site.

In the meantime, a search of the area revealed a wider distribution, east of Overlook Drive and 56th Street. The plant is well established on a grassy terrace adjoining the grounds of Temple Terrace School southside, and in the margin of a field about 1 block north of the school. Its sporadic occurrence was discovered in the area embracing largely the abandoned Henderson Hillsborough International Airport, extending over two miles northwest from Temple Terrace. There it is surviving in grassy and weedy vegetation along the old runways and road boulevards. Collection no. 24916, March 18, 1962 consists of post-mature plants with clusters of cymes, faded in everlasting fashion.

Discovery of the novelty raised the question of its specific identity. Dr. Carroll E. Wood, Jr., referred it tentatively to *Polycarpaea corymbosa* (L.) Lam. (*Achyranthes corym-*

bosa L. Sp. Pl. 205. 1753). The species with pantropic distribution was based on a Ceylon plant. An intensive study and investigation ensued. Specimens were sent to the Royal Botanic Garden, Kew, where they were critically examined in comparison with Kew materials from the various continents by Messrs J. P. M. Brennan and Peter Taylor. According to their esteemed report the Florida plant is different from *P. corymbosa,* the Asian-African taxon, but it differs less from *P. brasiliensis* Camb., the South American taxon. Since the identities of the above named taxa seem to be in need of an overall survey, the status of the Florida plant remains in question. However, it seems appropriate at this time to report the occurrence of *Polycarpaea* in North America. Meanwhile a study of the Florida plant is underway with hopes of gaining a better understanding of characteristics and affinities in relation to these known taxa.

It may suffice to point out the habit and the more prominent characteristics of the South American and the Old World taxa studied in collections. *P. brasiliensis* Camb., in St. Hilaire Fl. Brasil. merid. II. 132. (1829), a plant of Brazil, described without citations of particular specimens, is distinguished by thick, fusiform radix giving rise to several stems. Chodat et Hassler, in *Bulletin de L'Herbier Boissier* (2^me^*Ser.*) 3:790 (1903) treated Paraguayan plants as *P. corymbosa* var. *brasiliensis,* with a diagnostic statement, "Herba perennis, radix lignosa napiformis —" citing, *Hassler* Y-aca, Dec., n. 6691 & Apa. Dec., n. 8123, (F, GH, US). The leaves in South American specimens are strongly revolute, appearing filiform, with deeply cleft stipules prolonged to long filaments, and a terminal bristle to 3 mm. long. The radix is often lacking in herbarium specimens and the plant may be too young for a thickened crown; however, the leaf character may be an aid in identification.

P. corymbosa (L.) Lam., Rohrbach in Mart. Fl. Bras. XIV. 2 (1872) p. 254, t. 58, fig. 1, is representative of the Old World taxon, an annual plant with slender tap root, stems to 30 cm. tall, with internodes usually longer than the leaves, strict or more or less diffusely branched. The leaves,

despite the pubescence, with short terminal bristles and slightly revolute margins, are similar to those of the Florida plant. The collection of Cooley and Siyambalagstenne from Dambulla, Ceylon, 14-1-57, (USF), the type region, well conforms to the description of the species. The ten mounted plants bear a strong resemblance to those of China, India and Africa. These, like the South American plants, retain the cotyledonary fascicles and the basal leaves of the lower nodes almost through the flowering period. In the Florida plant they are lost in preanthesis. Therefore a conclusion of its identity cannot be made before the plant as a whole is understood. To verify the occurrence of *Polycarpaea* in North America the plant is herewith described.

DESCRIPTION OF THE FLORIDA PLANT

Upright annual herb 6-10 (14) cm. tall; taproot to 25 cm. long, with relatively few secondary roots; stem profusely branched through the upper half to two-thirds of its length; internodes 5-15 mm. long, scintillescent and reddish under the loose white pilosity, or glabrate; nodes with singular swellings of yellowish fatty parenchyma, embracing the axils of leaves with stipules, floral bracts and to a lesser extent those of the sepals; leaves linear, with revolute margins, 1-2.5 cm. long, 1-1.5 mm. wide, opposite, appearing verticillate with axillary fascicles, glabrous, fleshy, essentially sessile, excepting a few, in the cotyledonary node, 1-nerved, the nerve prominent below and terminating in a bristle about 1 mm. long, and, like the internodes, scintillescent and becoming reddish; stipules scarious, cleft, the points prolonged to filaments, 3-5 mm. long; inflorescence leafy, cymes dichasial, compound, terminating the numerous branches; floral bracts scarious, entire or cleft, overlapping the pedicels; flowers lustrous-white, 2.8-3.1 mm. long, perigynous; hypanthium short, crater-like, reddish within in anthesis; sepals scarious glabrous, lanceolate-acute, dorsally rounded, margins convex in outline, with a reddish-orange, deltoid, median basal spot; petals ovate, to 1 mm. long, entire or erose at tips, rose pink, fading to orange, connate with the stamen bases around the rim of the hypanthium; filaments subulate, curved inward, .4 mm. long, anthers white, oblong closely surrounding the stigma in bud; pistil in anthesis 1 mm. long, the short stipe centered within the hypanthium base; stigma consistently nearly sessile, or with style .13 mm. long, minutely papillose, 3-fid; capsule 1.5 mm. long, usually shed without the stipe, 3-valved, bronzed, the valve margins yellow, the stigma with style often short-persistent to a strand of inner tissue of one of the valves; ovules 7, amphitropous, seeds subreniform, com-

pressed, brownish, .3 mm. long when mature; before fully mature, the thin integuments clearly reveal the transparent endosperm with the curved embryo around the convex margin; cotyledons accumbent. Flowers, late August to November; ripe seeds to Jan. Known only from Tampa.

For citations and loans of herbarium materials, the author is indebted to Dr. C. Earle Smith, Jr., Chicago Museum of Natural History (F); Dr. C. E. Kobuski, Gray Herbarium (GH); Dr. J. R. Swallen, United States National Herbarium (US); Dr. James D. Ray, Jr., University of South Florida (USF); to Drs. G. Taylor and C. L. Hubbard of Royal Botanic Garden, Kew, for report of study. — UNIVERSITY OF SOUTH FLORIDA, TAMPA.

A NEW STATION FOR PINGUICULA VULGARIS IN ONTARIO.[1] — *Pinguicula vulgaris* L. is an amphi-atlantic species which has an uneven distribution both in Europe and North America. In the New World it is a boreal species which extends across Canada from Newfoundland to British Columbia and Alaska and south into northern New York, New Hampshire, Vermont, Minnesota, Michigan, Montana, Washington and Oregon. In Ontario *P. vulgaris* has been known for many years from the James Bay lowlands, Lake Nipigon and the north shore of Lake Superior, and the Bruce Peninsula which separates Georgian Bay from Lake Huron. A map of its distribution as known to Hultén is given in Kungl. Svenska Vetenskapsakademiens Handlingar, Fjärde Serien Band 7. Nr.1:231. 1958.

In the southern part of its range in northern New York State, this species is found only on wet limestone cliffs of deep cool ravines such as occur at Ithaca and the Finger Lakes. A similar situation was found in Wellington County, Ontario, near Elora, where the Grand River cuts through the Guelph Formation of Silurian limestone (dolomite).

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[1]Contribution No. 181 from the Plant Research Institute, Research Branch, Canada Department of Agriculture, Ottawa.

While botanizing on August 16, 1958, with Dr. W. G. Dore along the floor of the ravine cut out by the river, a a peculiar green was noted on the cliff on the opposite side of the river. Fast water along most of the base of the cliff made it difficult to get near, but it was possible to reach the water's edge on the north side of the river by climbing down a steep well-wooded slope nearby. We were then able to work along the foot of the slope to the cliff face. From there we could see the peculiar light yellowish-green leaves of *Pinguicula vulgaris*. The plants were very numerous, rooted in wet moss on what appeared to be a permanently wet and dripping rock face. By dint of much stretching we were able to secure eight plants, enough to make one herbarium sheet. All but one of the plants collected were sterile. The fertile plant bore an almost mature capsule. The data are as follows: ONTARIO: Wellington Co., Elora Glen, Grand River, in wet moss in bright sun, numerous but inaccessible on southfacing cut of gorge, *Cody & Dore, 11046* (DAO).

An examination of specimens in the University of Toronto Herbarium revealed another apparently unreported collection from along the Grand River some 30 miles to the south: Brant Co., Glen Morris, *R. F. Cain s.n.*, 8/6/29 (TRT).

Elora Glen and Glen Morris are approximately half way between the Bruce Peninsula, where *Pinguicula vulgaris* has been collected frequently, and the sites in northern New York. It is not far from the fault of the Niagara Escarpment which runs from the Bruce Peninsula into New York at Niagara Falls. This then might be the route by which this species reached northern New York and it is possible that other sites for *Pinguicula vulgaris* might be found in similar situations along the escarpment or where streams have cut through the sedimentary rock nearby. Such situations might possibly be found in the Niagara Gorge, along the Jordan River, at Credit Forks and along the Rocky Saugeen River. — W. J. CODY.

HYPTIS RADIATA (LABIATAE) AN ILLEGITIMATE NAME. — *Hyptis radiata* Willd., Sp. Pl. (ed. 4) 3 pt. 1: 84, 1800, was published as a new name for *Clinopodium rugosum* L., Sp. Pl. (ed. 1) 2: 588, 1753 (Willdenow of course cited ed. 3, with page no. 822, but the name originates in the first edition). Because the epithet *rugosum* was available for use under *Hyptis* but was not retained, the binomial *Hyptis radiata* is automatically illegitimate by present rules. Because of the validly published *Hyptis rugosa* Benth., Lab. Gen. et Sp. p. 86, 1832, the Linnaean epithet cannot now be transferred to *Hyptis*. In Carl Epling's "Synopsis of the genus *Hyptis* in North America" (Fedde Repert. Sp. Nov. 34: 73-130, 1933), the only available name seemingly is *H. latidens* Urban, 1926, three other binomials published by Gandoger in 1918 being listed as "nomina" only (l. c. p. 118). This is not correct, for Gandoger supplied Latin diagnoses in the form of keys, and cited specimens, so that all three of his names were validly published (Bull. Soc. Bot. France 65: 66, 1918). The identity of these will be discussed later.

The hitherto unidentified *Pycnanthemum ? alatum* Rafinesque, Fl. Ludov. p. 40, 1817, has never been listed in any synonymy under *Hyptis*, although Rafinesque himself thought it might really belong to that genus. Here is his account:

> 116. *Pycnanthemum ? alatum* Raf. — Foliis oblongis, acutis, dentatis, subtus tomentosis, longe petiolatis, petiolis alatis, capitulis longe pedunculatis, involucris 13 phyllis, alternis longioribus. Raf. — Monarde bouton Rob. p. 388. Stems four feet high, four angular, grooved and branched, leaves green above, flowers white, unfolding gradually. Faintly aromatic and bitter: vulgar name *herbe à bouton;* Robin owns it has four stamina: but says it has all the other characters of *Monarda*. It is perhaps a *Hyptis*.

Anyone who has seen the Gulf Coast *Hyptis radiata* will recognize at once that it is exactly what Rafinesque de-

scribed. Since his specific epithet has not been used under *Hyptis*, and is much older than those of Gandoger and Urban, the correct name for *H. radiata* becomes *H.* **alata** (Raf.) Shinners, comb. nov., based on *Pycnanthemum ? alatum* Raf., quoted above.

Of the three species published by Gandoger (all on the same page), the first, *H. floridana*, was described as "pubescens, caulis copiose setoso-muricatus, folia basi rotundata deltoidea, bracteae florales calyce breviores, sepala vix ½ mm. longa. — Florida, ad Jacksonville *(Williamson!)*." The pubescent and muricate stem, broad leaf blades, small floral bracts, and very short calyx teeth are all perfectly characteristic of *H. mutabilis* (A. Richard) Briquet, and *H. floridana* Gandoger is to be listed as a synonym of that species rather than of *H. alata (H. radiata)*. Gandoger's other two species are discussed together separately from *H. floridana*, and are plainly forms of *H. alata*. The third is the common and widespread type, identical with *H. radiata* Willd. and *Pycnanthemum ? alatum* Raf.: "Involucri phylla capitulum villosum superantia, caules ad angulos hispiduli, folia late oblonga. — America sept., Mississippi ad Biloxi (*Tracy* n. 61!) et ad Mendenhall (*ejusdem* n. 8757!)." The first number cited is adopted as lectotype of *H. Tracyi*. I have seen only topotype material (*Demaree 28392*, SMU).

Gandoger's second species, *H. leiocephala*, was a more glabrous and narrow-leaved form: "Involucri phylla capitulo glabro breviora, caules ad angulos glabri, folia anguste oblonga. — Florida, ad Jacksonville *(Keeler! Leggett!)*." This sounds very similar to *H. latidens* Urban, Fedde Repert. Sp. Nov. 22: 368, 1926, from Cuba, considered by Epling only a form of *H. radiata* not worthy of recognition. Because the extremes are so different in appearance, because the narrow-leaved one is geographically segregated, and because it is a significant piece of evidence about the history of the Southeastern flora, I think that the formal designation of a variety is justified. Not having seen either Gandoger's or Urban's specimens, I prefer to supply an entirely new name based on material I have examined:

Hyptis alata var. **stenophylla** Shinners, var. nov. Caulis (nodis exceptis) glaber vel subglaber. Folia caulina angusta plerumque laminis lanceolatis vel lineari-lanceolatis paucidenticulatis vel subintegris. TYPE: northwest of Loxahatchee in the Corbitt Wildlife Management area, Palm Beach Co., Florida, *R. Kral 5657*, 3 Sept. 1957 (holotype SMU, isotype FSU). "Frequent on moist to wet sandy peat of broad marsh and grass-sedge meadows." The leaf blades of these specimens are linear-lanceolate and subentire. In the following they are lanceolate and mostly few-toothed. All are from lower peninsular **Florida.** CHARLOTTE CO.: 15 miles north-northwest of Fort Myers, *Kral 7502* (FSU). Caloose Experimental Range, southeastern Charlotte County, *William P. Adams 218* (FSU). COLLIER CO. vicinity of Lake Trafford, about 3 miles west of Immokalee, *Adams 208* (FSU). One mile south of Ochopee, *Richard S. Mitchell 630* (FSU). DADE CO.: 5 miles west of Naranja, *F. H. Sargent 6451* (SMU).

As indicated above, *H. leiocephala* Gandoger and *H. latidens* Urban are very probably synonyms of var. *stenophylla* rather than of var. *alata*. Unless it is desired to recognize two species, the precise disposition of these names is of no consequence.

I am greatly indebted to Dr. R. K. Godfrey for the loan of herbarium material from Florida State University. — LLOYD H. SHINNERS, SOUTHERN METHODIST UNIVERSITY, DALLAS 22, TEXAS.

MAKERS OF NORTH AMERICAN BOTANY[1]

Who are the Makers of North American Botany? — When Dumas Malone and his associates organized the *Dictionary of American Biography* they posed the simple criterion when selecting the persons to be included: Did the botanist influence the American scene? Certainly not only the innovators but those who developed the science should be included. The *DAB* includes forty botanists[2] that are not mentioned by Humphrey. They are:

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[1]*Makers of North American Botany.* By Harry Baker Humphrey. Edited by Robert R. Humphrey. Ronald Press, New Pork. $6.00 xi + 265 pp. 1961.

[2]See *DAB Index* volume, 373. 1943 and Supplements I and II.

W. P. C. Barton,[3] W. D. Brackenridge, Robert Bridges, S. B. Buckley, Henry James Clark, John Clayton, Manasseh Cutler, Stephen Elliott, B. T. Galloway, F. H. Knowlton, Arthur Hollick, Henry Kraemer, Adam Kuhn, J. G. Lemmon, F. J. Lindheimer, Thomas Meehan, Ezra Michener, Elisha Mitchell, John Mitchell (d. 1768), Charles T. Mohr, J. S. Newberry, John Alsop Paine, Andrew Parmentier, F. P. Porcher, T. C. Porter, John L. Riddell, J. N. Rose, J. T. Rothrock, H. H. Rusby, P. A. Rydberg, H. P. Sartwell, J. L. E. W. Shecut, C. W. Short, George Thurber, Edward Tuckerman, L. M. Underwood, Thomas Walter, David White, E. H. Wilson, Charles Wright.

Certainly no two authors would select the same "makers of North American botany" but most, if not all, of the foregoing *DAB* biographees might be expected in a book described as "invaluable for biographical reference." Some other 'makers' that come to mind are David Hosack, who patronized botany and founded the Elgin Botanic Garden; Bernard M'Mahon, author of the first gardeners' guide to be printed in this country; Eugene Waldemar Hilgard, soil scientist and pioneer agronomist; John Belling, cytologist and stain technologist; Edward Palmer, ethnobotanist and zealous collector in remote regions of Mexico and the West; Almira Lincoln Phelps, student of Amos Eaton, author of an influential textbook used in women's colleges; David Fairchild, pioneer in the field of plant introduction, author of *The World was my Garden,* one of the best botanical story books of the century; Wilhelm Seifriz, geobotanist, physiologist, pioneer in protoplasmic studies; Edward Wilbur Berry, productive paleobotanist, whose knowledge of fossil plants surpassed many botanists' knowledge of living floras! and Alice Eastwood, whose seeds of enthusiasm for botany were sown in thousands of minds for over seventy years!

Dr. Humphrey did not live to see his book published and it was brought to print by his son who added a few sections to the account of 122 botanists. Regrettably the reference value is diminished by at least 94 typographical errors in the citation of names, dates, and bibliographical references

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[3]Absence of Benjamin Smith Barton from the *DAB* is notable in view of his important role in fostering colonial botany. See Jeannette E. Graustein, *Penna. Mag. Hist. and Biog.* 85: 423-438. Oct. 1961, for the latest "informed judgment" on Professor Barton.

to render the book unreliable. This is partly failure to read proofs carefully, but there are many inconsistencies in the citation of references which were surely in the original manuscript.

Humphrey was evidently unaware of a number of important studies of some of the botanists he considered. How can he write of Rafinesque and not make use of Merrill's essays? Of Bartram, and not use Francis Harper's? Of Benjamin Smith Barton and of Muhlenberg and many other Philadelphia figures, and not use Pennell's contributions? He paid too little attention to the formative influences in the lives of the 'makers!' An index would have served as a guide to the influence of mentor on student, to contemporaries, such as John Belling, now lost within accounts. The outstanding contribution of the botanist is too often smothered in the recitation of medals and memberships. Humphrey's garland of botanical worthies is not a book of recollections written for the uninitiated reader browsing for pleasure. He wrote impersonally as if he feared intimacy even for those colleagues in his old United States Department of Agriculture whom he must have met almost daily. His prose is without relief in the recital of facts.

Only a few factual errors have been noticed. "Rev. Dr. [Zaccheus] Collins" mentioned as a Philadelphian who befriended F. A. Michaux was neither a minister nor a physician but a merchant. The oft-repeated misalliance of Audubon with Albert Kellogg has been corrected by Professor Geiser(1).

More numerous are the fallacious interpretations that appear all through the book. For example, to say E. L. Greene "had more than a casual interest" in *Pittonia* and *Erythea*, — journals which he had founded — is a singular understatement. Lewis David von Schweinitz's herbarium "became the property of the Academy of Natural Sciences of Philadelphia," it is true, but the lamentable scheme of von Schweinitz in discarding the collectors' original labels in favor of his own copied tickets is not mentioned. Humphrey's statement conveys the impression that this collection

of "approximately twenty-three thousand species" is valuable when in fact its value was seriously impaired (2). Humphrey infers that Sargent illustrated his *Silva* with 740 plates by his own hand when they were the work of Charles E. Faxon, a high point in American botanical illustration. Again and again the works of botanists are cited as 'solo flights' when rather they were co-authored by others who go unnoticed. Thus some notable events in American botany are missed altogether such as when Wilfred Robbins and Richard Holman created a winning text which was to outsell all competitors for nearly thirty years. It was recently revised by professors Weier and Stocking. Pursh is said to have worked on a flora of Canada making "several important botanical excursions," and assembling "important collections." Both are misleading statements, certainly not supported by the evidence which I presented in the paper that Humphrey cited. Pursh worked desultorily, frustrated partly by ill health brought on by discouraging lack of support for western exploration and by alcoholism. The few surviving Canadian collections (which evidently were thought unworthy of mounting by Lambert, Pursh's patron) give no impression of his former sharp eye for novelties and overlooked range extensions seen in his Virginia and New York collections. Nuttall's trip up the Missouri River with John Bradbury is misleadingly reported by Humphrey. Graustein's papers, overlooked by Humphrey, should be consulted regarding this relationship (3). William T. Hornaday, not D. T. MacDougal, wrote *Campfires in Desert and Lava*. Humphrey confused facts about Dr. Engelmann. The collected *Botanical Works* of Engelmann were a reissue of his many scattered papers, the original "notes, drawings, and data" of which are to be found in the sixty volumes preserved at the Missouri Botanical Garden. Amos Eaton never held a faculty appointment at Yale; in fact, he himself wrote that he had been "a mere learner at Yale." McAllister's *Amos Eaton* would have set Humphrey right on this point. Elias Durand's herbarium presented to the Jardin des Plantes represented a selection of one or a few sheets

of each species described from North America, — often removed from the Philadelphia Academy's collections! — to make up what Durand called the *Herbarium Boreali Americanum*. Agnes Chase and F. W. Pennell have recorded these facts(4). Jane Colden prepared notable descriptions of New York state plants, though her drawings were indeed indifferent. Together they fortify Humphrey's decision to include this remarkable young woman in the garland of North American botanists(5). To call T. S. Brandegee "one of the first pioneer plant collectors of the West" is to overlook the roll of honor drawn up by Alice Eastwood(6) which includes Collignon, Mocino, Haenke, Menzies, Chamisso, Vosnesensky, Douglas, Hartweg, Jeffrey, etc., — all prior to Brandegee in the West! There is no doubt of the importance of Brandegee in the extent and excellence of his collecting but Humphrey does not make this clear.

Notable is the considerable number of men who rose from amateurship to make a permanent mark in American botany. If an early motivation in the lives of these 'makers of North American botany' were sought in these sketches, it would be the appeal of the American outdoors. Sense of exploration played an important part in the formative years of botanists who ultimately were to enter the experimental laboratory as well as in those who were to leave their largest contribution in field botany.— JOSEPH EWAN, TULANE UNIVERSITY.

1. *Field and Lab.* **27**: 94. 1959.
2. F. W. Pennell in *Bartonia* **16**: 1-8. 1935.
3. *Chronica Botanica* **14**: 1-88. pls. 68-79, 1951; *Mo. Hist. Soc. Bull.* **12**: 249-252. 1956.
4. *Bartonia* **17**: 33-39, and 40-45. 1936.
5. Anna Murray Vail in *Torreya* **7**: 21-34. 1907.
6. *Calif. Hist. Soc. Quart.* **18**: 335-346. 1939.

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ERNEST JESSE PALMER. 1875-1962*

Ernest Jesse Palmer died at Webb City, Missouri February 25, 1962 in his 87th year. This marked the end of a long and in many ways remarkable career in the fields of botany and allied sciences.

He was born in Leicester, England April 8, 1875 and in 1878, when he was three years old he and his sister, Louise, were brought to this country by their parents, Amos and Annie Palmer, who settled temporarily near Warrensburg, Missouri in Johnson County.

At the age of 14, his father, responding to the stories of quick wealth offered by the mining opportunities in the southwestern part of Missouri, moved his family to Webb City and built a home for them at 321 South Main Street. The wealth never materalized! Throughout the rest of his life, although he spent many of his years away from Webb City, the Palmer home was maintained and after retirement Palmer moved with his family and lived out the rest of his life there.

In this mining area, young Palmer did find a wealth of his own liking. It was here that he began his studies of natural phenomena. In the piles of waste material from the mines, fossils of plants and animals caught his fancy and as in all boys of his age the collecting instinct came to the fore. He developed a very keen instinct for unearthing the most interesting artifacts. In later years at the Arnold Arboretum

*This article on the life of Mr. Palmer will be published also in the current volume of the Journal of the Arnold Arboretum. Included in the Journal will be a bibliography of Mr. Palmer's published papers compiled by Mrs. Lazella Schwarten and Mrs. Ernest Palmer.

he was always "picking up" Indian arrowheads and other Indian deposits. This was easy for him — but not necessarily for others. I can recall his telling me of a spot in the Arboretum where arrowheads were in abundance. I hurried to the exact location but found nothing. The next day we went out together — and sure enough, he picked up several more artifacts. Eventually two attractive trays of Palmer's finds in the Arboretum were mounted and have been on display there ever since.

His formal education was broken off suddenly while he was attending high school. A physical collapse of his father made it necessary for him to leave school and seek employment. This was undoubtedly a severe blow to his pride because he wanted an education above all things. He loved study and research — and he intended to continue it at all costs. Just recently I learned from an article by Marcia W. Kershaw, a Special Correspondent, of the St. Louis Post-Dispatch that Palmer managed to study Latin and Greek at old Webb City Baptist College. I had often wondered where he obtained his profound knowledge of these languages, especially Latin which he used so ably in his original technical descriptions of new species of plants. Mrs. Kershaw's article brought to light many other facets of Mr. Palmer's career which were previously unknown to me and I am very thankful to her for her assistance.

All his life he had managed to study not only the Natural Sciences but also English literature, mathematics, economics and poetry until he was considered very proficient in each of them.

The portrait which accompanies this article is very recent and shows Mr. Palmer at his desk with a copy of his published book of poems entitled, "Gathered Leaves, Green, Gold and Sere." These poems, I understand are truly gathered leaves, "leaves" which had been lying around in various places during the years and were gathered together by his wife and published through her efforts when Palmer was eighty-three years old.

His scientific papers were noted not only for his Latin descriptions but also for the fine phrasing which he always

employed. He wrote so well and so easily that often he found it necessary to delete whole paragraphs from his papers because he considered the contents "unscientific." It was a pity — because everyone would have enjoyed reading them.

Although he was dedicated to the life of a naturalist it was not until his meeting with Benjamin Franklin Bush, also from Missouri, that he tried his wings and ventured away from his home setting. When Bush died in 1937, Palmer published a resumé of his life in "The American Midland Naturalist." On re-reading this biography one cannot help but be struck by the similarity in the early backgrounds, the interests and, in fact, the entire careers of the two men.

In 1901, Bush, then a collector for the Arnold Arboretum, visited the Palmer home and spent a week there using it as a base for his botanical collections. Bush was especially interested in obtaining specimens of *Crataegus* for C. S. Sargent, then director of the Arnold Arboretum, and when he departed from Webb City he left with Palmer a supply of dryers for further collections. Thus at the age of 25 Palmer began his life long interest in *Crataegus* and his association with Sargent and the Arnold Arboretum. For the next twelve years he collected extensively in his home area concentrating on the flora of Missouri and it was not until 1913, when he was 38, that he became associated with the Missouri Botanical Garden. Two years later at the age of 40 he began his many collecting trips to the southwest under the aegides of both the Missouri Botanical Garden and the Arnold Arboretum.

Palmer began publishing as early as 1910, at which time his first paper, "Flora of the Grand Falls Chert Barrens" appeared in the Transactions of the Academy of Science, St. Louis. During the next ten years he published seven papers, mostly on ferns. In 1920, while still a collector-at-large he sent in from Webb City to the newly organized Journal of the Arnold Arboretum his first of many papers to be published by this Harvard University publication. Two more papers were published in this journal before he came to Jamaica Plain in 1921 as a regular staff member. He

retained this status at the Arnold Arboretum for twenty-seven years, until he retired in 1948.

My personal association with Palmer began in 1927. By that time he was firmly established at the Arboretum as a collector-botanist. Since he was away so much of the time on his many collecting trips and since he was still a bachelor he maintained personal quarters in a rooming house.

He was a very busy man during this period. He managed to make a collecting trip nearly every year, usually alone, occasionally with a single companion. Upon his return from these trips his time was spent identifying his specimens, making up sets for distribution, and writing occasional papers — and getting ready for his next trip. He once mentioned to me that he had hopes of collecting in all the states of the Union. At the time he had nearly accomplished his intentions. If I recall correctly he said that there were only two states in which he had not made "official" collections — and as one might suspect one of them was surprisingly close by!

The greater portion of his collections were made in the southwestern United States. However, he always maintained his interest in the Missouri flora and in 1935 there appeared in the Annals of the Missouri Botanical Garden the 385 page article by Palmer & Steyermark," An Annotated Catalogue of the Flowering Plants of Missouri." This catalogue is more complete than is usually found in such a publication. The first seventy-five pages are devoted to the botanical history, terrain, climate, plant regions etc. of the state. Under the actual listing of the taxa may be found the habitat and a record of the counties wherein specimens of each entry had been collected. A footnote states that an earlier publication of the ferns and fern allies of Missouri published by the same authors three years earlier in the American Fern Journal should be considered supplementary to the 1935 Catalogue.

A recent letter to me from Julian Steyermark, the junior author of the above two publications mentions that his latest publication "Flora of Missouri" which has been in press

since 1959 is being dedicated to E. J. Palmer. Palmer had hoped to see the book and knew of the proposed dedication.

In 1930, when he reached the age of 55 he surprised us all by getting married. We had thought of him as a confirmed bachelor. He married Elizabeth McDougal, a bacteriologist at the Massachusetts State Laboratory which is located along side the Arnold Arboretum. Naturally, a great change took place in Palmer's life. He eventually set up a very fine home in one of the houses belonging to the Arnold Arboretum in Jamaica Plain. He and his wife had three children, Ernest Macdougal Palmer born in 1931, Grace Elizabeth Palmer in 1932, and Theodore Windle Palmer in 1935.

Palmer possessed a physique that defied age. He was the slender, wiry type and at the time of his retirement and departure from Jamaica Plain for Webb City could outlast any of us on a collecting trip. Although I did not see him again I understand from his long letters and from various conversations with others that he continued his same brisk manner in everything which he undertook. His letters show that when he retired he merely transferred his activities from Massachusetts to Missouri. In a letter to me in February 1955 he says: "Of course we miss many friends there [Jamaica Plain], and I miss many of the associations at the Arboretum. But I have never been sorry that I retired when I did, for my life on the whole has been quite happy here. I have never been busier at any time or interested in more things. In April I will pass another anniversary — and you can figure it out as the records show that I was born in 1875. It is hard for me to believe it as I still feel as strong in body and mind — so far as I can tell — as I did at fifty. I can easily walk ten miles any day; and I think I could climb a good sized tree, if there was anything at the top of it that I wanted badly enough. . . . Steyermark and I are still working actively on the Flora of Missouri. . . . Specimens of Crataegus, Quercus and other genera keep coming to me for determination or revision. . . . Other collections in my museum also occupy much time. . . . I have agreed to talk to a joint meeting of all the Garden Clubs of Carthage at the

public library. While I do not solicit or particularly enjoy speaking engagements, I fill them occasionally. . . . It is so fine and warm today that I think I will go fossil hunting this afternoon." For a man retired and eighty years old he certainly was enjoying life to the fullest, doing exactly what he wanted to do — and he seemed so well equipped to do it!

During his life time Ernest Palmer joined many scientific organizations, among them: the American Fern Society, the American Association for the Advancement of Science, the American Society of Plant Taxonomists, the Boston Mineral Club, the Botanical Society of America, the Missouri Archaeological Society, the New England Botanical Club (past president 1944-1945), and the St. Louis Academy of Science.

CLARENCE E. KOBUSKI,
ARNOLD ARBORETUM AND GRAY HERBARIUM,
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SOME OBSERVATIONS ON FLOWERING IN RUELLIA (ACANTHACEAE)

ROBERT W. LONG[1] AND LEONARD J. UTTAL

During the past four years the authors have been making systematic observations on transplants and natural populations in *Ruellia*, commonly referred to as "wild petunia".[2] Although primarily tropical and subtropical in distribution, this genus is represented in eastern United States by 11 species of low, perennial herbs with opposite leaves and large blue or lavender, funnelform flowers.

Ruellia is a difficult genus for the taxonomist because of the absence of reliable characters in certain species. Twenty varieties and forms have been described in *R. caroliniensis*

[1]Present address, Department of Biological Sciences, University of South Florida, Tampa, Florida.

[2]We wish to thank the following persons for their courtesy in supplying us with *Ruellia* materials for greenhouse cultures: Drs. J. T. Baldwin, R. E. Woodson, R. K. Godfrey, W. H. Duncan, J. D. Ray, G. S. Winterringer, Mr. K. E. Bartel and Mrs. T. C. Lacey. Voucher specimens for these cultures are deposited in the Herbarium of the University of South Florida.

(Walt.) Steud. and *R. humilis* Nutt. (Fernald, 1945; Tharp and Barkley, 1949) largely on the basis of minor character differences. Fernald did much to clarify the nomenclature, but his classification of eastern species is complex and difficult to use. It is now apparent that a major cause of this is a poor understanding of the reproductive biology of these plants. Monographic treatments of *Ruellia* have been based almost entirely on herbarium specimens, and no attempt made to investigate plants in culture or extensively in the field.

This report attempts to clarify the relationship of cleistogamy to normal flower-production (chasmogamy) and to describe the reproductive behavior of certain eastern U. S. species as far as they have been investigated. Four species are included in this discussion, all except one having been observed in both garden and greenhouse cultures, and in the field. In these species the following kinds of breeding systems have been observed: obligate and facultative cleistogamy, the latter condition either coincident with chasmogamy or sequential; obligate and facultative chasmogamy; chasmogamy involving normal-sized corollas, and these either long-styled, medium-styled, or short-styled; chasmogamy involving small-sized corollas, called here "miniatures", that are approximately half as long as normal flowers; facultative proterogyny was regularly observed in some greenhouse plants, although synanthesis is usual in *Ruellia;* finally, polygamy was noted in two species discussed in this paper, involving apetalous, pistillate flowers in one and staminate, petaliferous flowers in the other.

Ruellia strepens L. (5 natural populations examined, Ohio and Virginia; 3 greenhouse cultures, Ohio and Virginia). This species has been studied the most extensively of all and is perhaps the best known one to taxonomists because of its wide distribution in the Middle West. It is readily separable from other eastern species by means of its lanceolate calyx lobes; other species have linear or setiform sepals. *Ruellia strepens* is remarkably uniform between and within populations. Chasmogamous flowering begins in late April and continues to mid-July, followed by small, greenish-

yellow cleistogamous flowers produced from late June to the first frost and borne in sparse to congested subsessile, axillary glomerules. Plants occasionally do not produce any flowers for a period between reproductive phases.

Ever since Gray (1878) formalized a varietal status for cleistogamous plants of *R. strepens*, differences of opinion have existed as to the nature of such plants. Chapman (1884) reported late flowers sometimes set fruit in the bud. McCoy (1937), after observing a single garden transplant, reported cleistogamy sequential to chasmogamy in the same individual. Nevertheless, recent monographers (Fernald, *ibid.;* Tharp and Barkeley, *ibid.*) have continued to describe cleistogamous specimens as either forma *cleistantha* (Gray) S. McCoy or var. *cleistantha* Gray. We have observed hundreds of plants of *R. strepens* in a total of 5 populations. In all instances cleistogamy regularly follows chasmogamy except that young plants appear to be exclusively cleistogamous in their first year of flowering. In addition, greenhouse cultures of plants collected during the chasmogamous phase later produced cleistogamous flowers. Immediate environmental factors strongly influence the production of flower-types. Thus, cleistogamy is precocious in sear, open habitats, whereas chasmogamous flowering is prolonged by shade, moisture, and rich soil. Moreover, cleistogamous plants may revert to chasmogamy as a result of prolonged cool or cloudy weather. Also, chasmogamy may coincide with cleistogamy for a period of time. Greenhouse cultures of this species have never flowered chasmogamously, even in May and June, but produce only closed flowers; garden transplants produce both chasmogamous and cleistogamous flowers.

The earliest flowers of *R. strepens* apparently are seldom pollinated and thus rarely form seeds. Observations of natural populations reveal that, although abundantly produced, chasmogamous flowers are infrequently visited by insects. Early seed-production is mostly destroyed by Lepidopterous larvae, but insect-depredations taper off in early autumn. Plants thus appear to produce seed abundantly in their autumnal cleistogamous phase. Although

Fernald noted the low seed-production of chasmogamous flowers, and the correspondingly high production of cleistogamous ones, he failed to explain why his open-flowered variety appeared to be more common than the closed-flowered variety.

Three kinds of chasmogamous flower-structures have been observed in this species: (1) early chasmogenes with anthers about the throat orifice and with the stigma much exserted on a long style; (2) a later-appearing chasmogene, but one which may appear coincidentally among earlier flowers, with anthers and stigma borne at approximately the same level; (3) a less common type, with a short style resulting in the stigma being below the level of anthers. Thus, partial heterostyly exists in *R. strepens* which, even in chasmogamous flowers, tends to favor inbreeding. Open-flowers last only part of the day; ordinarily anthesis occurs soon after sunrise and corollas fall from the receptacle shortly after noon. *Ruellia strepens* apparently is a habitually inbreeding species with very few biotypes, these hardly dissimilar morphologically, resulting in homogeneous populations.

Ruellia caroliniensis (Walt.) Steud. (10 natural populations examined, Florida, North Carolina, South Carolina, Virginia; 11 greenhouse cultures, Virginia, Kentucky, Florida, Georgia, North Carolina, South Carolina). This species has been described as the most perplexing *Ruellia* of eastern North America (Fernald, *ibid.*). Field work has been carried out in Virginia, North and South Carolina, and Florida. In this region a number of varieties and forms have been described by Fernald, none of which is accepted by Gleason (1952). Judging from the variations in greenhouse and garden transplants, *R. caroliniensis* is apparently the most racially complex member of the genus in North America. Few, if any, of these races may deserve taxonomic recognition, but definite taxonomic evaluations can not be made at this time. Although the species varies widely, plant-to-plant variability within populations is negligible. The interpopulation variability of *R. caroliniensis* probably is correlated with the wide range of habitats in which this species can be found.

Both chasmogamous and cleistogamous flowers are produced in a manner essentially similar to *R. strepens*. Chasmogamous flowers are produced abundantly in the spring but apparently rarely set fruits. Cleistogamous flowers, previously unreported for this species, occur in the summer and early autumn with abundant seeds produced. In *R. caroliniensis* races have been grown in the greenhouse that form only chasmogamous flowers, but if hand-pollinated, produce normal fruits with seeds that germinate readily. Short-styled and long-styled flowers occur in the same individual with long-styled flowers predominant. One greenhouse race was quite variable, producing staminate flowers, "miniature" flowers, and exhibiting proterogyny occasionally. Another race produced only cleistogamous flowers.

Ruellia humilis Nutt. (2 natural populations examined, Ohio and Virginia; 10 greenhouse cultures, Illinois, Texas, Kansas, and Ohio). This species, occurring primarily in the prairies and plains of central United States, has been segregated into a number of varieties. Fernald reports cleistogamy as rare, but observations show the reverse to be true. Flowering may be chasmogamous or cleistogamous, sequentially or coincidentally. Cleistogamous flowers are produced more abundantly in all races as the season progresses. Chasmogamous flowers with the long-exserted stigmas predominate, but one greenhouse culture occasionally produced short-styled ones. This same race regularly formed chasmogenes and cleistogenes simultaneously rather than sequentially as is generally true for the species. In *R. humilis* greenhouse observations revealed that, although pollinators were absent, chasmogamous flowers usually formed fruits. This was owing to the manner in which the corolla was shed from the receptacle, resulting in the epipetalous stamens coming in contact with the exserted stigma. This same mechanism was observed in other species but not so regularly as in *R. humilis*.

Ruellia pedunculata Torr. (6 greenhouse cultures, Texas) This is a remarkably stable species, morphologically, that characteristically produces long-stalked blue, lavender or white flowers. It is distributed widely in Texas, the Ozark-

ian uplands and into southern Illinois. The reproductive systems of this species, as reflected by the kinds of flowers produced, are among the most complex of any investigated this far.

Cleistogamy occurs regularly in all greenhouse cultures along with open-flowers, although apparently this has not been noted before. The closed-flowers measure about 1.0 cm. long, are white with greenish-brown tips, and may occur coincidentally with open flowers or sequentially with open flowers. Evidentally, here, as in *R. humilis* and *R. caroliniensis* there exist at least two races differing in the timing of flower-production. Partial heterostyly, similar to that in *R. strepens*, occurred frequently in one race. Long-styles measure 2.5-3.0 cm. long and short-styles only 1.0-1.5 cm. long, well within the throat of the corolla and below the stamens. Long-styled flowers failed to form fruits when protected from insects and not hand-pollinated. Short-styled flowers always formed fruits.

A fourth kind of flower appeared in two cultures. This was an apetalous, pistillate flower with a short-style. That this was not merely a cleistogamous flower that had shed the corolla was established by repeated observations. The occurrence of these unisexual flowers was sporadic but coincident with open-flowers. All classes of flowers were functional and could form normal fruits, but apparently in nature the species is habitually self-pollinated.

No field work has been possible with *R. pedunculata* as yet, but observations reported here are based on 80 greenhouse transplants distributed in 11 different races. There is relatively little morphological variation within and between these races despite the fact that most of the collections came from regions of sympatry with *R. caroliniensis* and *R. humilis*. *Ruella pedunculata* can be hybridized with these two species but natural hybrids are unknown at the present time.

CONCLUSIONS

Breeding experiments with greenhouse and garden cultures are in early stages and only preliminary results have been obtained (Long, unpubl.), but apparently all classes

of flowers in these four species are functional and can form fruits with viable seeds. Field observations, however, indicate that *Ruellia* species are habitually self-pollinated. The relatively small amount of morphological variation in *R. strepens* and *R. pedunculata* suggests that outcrossing seldom takes place. On the other hand, Long (1961) adduced evidence from herbarium samples and hybridization experiments that crossing of *R. humilis* and *R. caroliniensis* probably does occur and that at least some of the apparent intergraduation between these species may be attributed to natural hybridization. More detailed and extensive observations are needed on species thus far only partially investigated, such as *R. ciliosa, R. heteromorpha* and *R. purshiana* as well as on numerous North American species as yet poorly known. Apparently, however, *R. strepens, R. caroliniensis, R. humilis,* and *R. pedunculata* are examples of plants that are functionally autogamous but with many of the typical flower structures of allogamous ones.—DEPARTMENT OF BOTANY AND BACTERIOLOGY, OHIO WESLEYAN UNIVERSITY, DELAWARE, OHIO; AND ROUTE 3, MADISON HEIGHTS, VIRGINIA.

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DRYOPTERIS DILATATA (HOFFM.) A. GRAY IN NORTH AMERICA

DONALD M. BRITTON

Taxonomic authorities have differed widely in their interpretation of the species of *Dryopteris* in North America which resemble the old world *Dryopteris dilatata* (Hoffm.) A. Gray. Fernald (1) considered the fern that is found in the Appalachians north to Quebec and Labrador, and yet resembles *D. dilatata* superficially, to be a variety of *D. spinulosa* (O. F. Müll.) Watt, namely *D. spinulosa* var. *americana* (Fischer) Fernald, whereas Morton in Gleason (2), refers to this entity as *D. austriaca* (Jacq.) Woynar var. *austriaca*. There has been similar disagreement concerning the species found in Montana and Oregon north to Alaska, although Taylor (3) employs the latter designation for the common form in British Columbia.

In a recent article in Brittonia, Wagner and Hagenah (4) have suggested that not only are the eastern and western entities separate species, but that within the range of Gray's Manual, *D. spinulosa* var. *americana* should be further separated into two species. Some evidence for the latter separation is found from Walker (5) who reported that *D. spinulosa* var. *americana* (*D. campyloptera* (Kunze) Clarkson) from Vermont and also Quebec is tetraploid (4X) (x=41), whereas Wagner reports that ferns in Michigan previously referred to as var. *americana* are diploid. I am in full agreement with these cytological findings because last spring I studied 12 collections of var. *americana* from Jefferson Notch and Mt. Washington, New Hampshire collected by R. and A. Tryon and all were tetraploids (Tryon 5684, 5689-5700 June 25, 1961). In 1960, I studied 11 collections of var. *americana* from Mile 80, north of Sault Ste. Marie, Ontario and these were all normal diploids (2X) (B373-383 June 23, 1960).

However, I take strong exception to the authors' suggestion that the Lake Superior diploid cannot be identified with western *D. austriaca* var. *austriaca* although both are diploid. The cytological argument is quite circuitous. Walker

(5) has named the diploid species of *dilatata* of the old world, *D. assimilis* S. Walker, and has considered that morphologically and cytologically *D. maderensis* Alston is inseparable from *D. intermedia* (Muhl.) A. Gray. (There is normal meiotic pairing between the chromosomes of *maderensis* and *intermedia*). In the two hybrids studied from a cross between *D. maderensis* × *D. assimilis*, Walker (5) found that there was also normal pairing but that ca. 40% of the spores aborted. He concluded on the basis of chromosomal homologies that *intermedia* and *assimilis* represented the same ancestral genome. Walker further suggested that "morphological similarity between the Vancouver diploid and *D. assimilis* suggests that they represent the same genome and possibly the same species." This conclusion was fortified by the fact that the progeny of the cross of the Vancouver diploid with the United Kingdom tetraploid *dilatata* gave the same cytological picture as the cross *D. assimilis* (2X) × *D. dilatata* (4X) namely ca. 41 pairs and 41 single chromosomes in meiosis. Wagner and Hagenah (4) found one hybrid between the putative parents *D. intermedia* and the Lake Superior diploid and report that there is little or no chromosomal pairing between the genomes of this plant, although the number of cells studied and the number of clear meiotic plates analysed is not given. Accordingly, they contrast Walker's cross (two plants) of *D. maderensis=intermedia* × *D. assimilis* with their one hybrid of *D. intermedia* × Lake Superior diploid, and conclude that if *D. assimilis* is identical with the Vancouver diploid then the Vancouver diploid is unlike the Lake Superior diploid. However, as yet we have no *direct* comparisons between these diploids. What is needed are hybrids between (a) the Lake Superior diploid and the western diploid (b) the Lake Superior diploid and *D. assimilis* and (c) the Western diploid and *D. intermedia*. It should also be evident that many more plants should be studied cytologically before reaching sweeping conclusions from meiotic analysis of one or two plants, some of which are hybrids of putative parents.

Although a cytotaxonomist is apt to be impressed with the evidence presented by Walker (5) to consider *D. ma-*

derensis Alston and *D. intermedia* (Muhl.) A. Gray as conspecific, there has as yet been no adequate taxonomic treatment to substantiate this conclusion.

It would seem extremely hazardous to put too much emphasis on pairing in spite of its great usefulness in genome analysis. *D. intermedia* and *D. assimilis* are morphologically separable and yet show good pairing, hence would be one species using this latter criterion alone. In fact this would leave *D. assimilis* Walker, *D. maderensis* Alston, *D. austriaca* var. *austriaca* in British Columbia, and *D. intermedia* as being all the same ancestral genome and the same species on the basis of genome analysis. The Lake Superior diploid, however, which so closely resembles the British Columbia diploid in morphology, and *must* be closely related, is then considered to be an entirely different species merely on its pairing behaviour with *intermedia*.

Two pieces of cytogenetic evidence should be kept in mind to temper the use of the criterion of chromosome pairing. One is the finding in wheat that pairing is under genetic control and governed by the presence or absence of genes for synapsis (6). If this should prove to be true in *Dryopteris*, the basis of genome analysis would be invalidated. The other point may be related, and concerns races of *Asplenium trichomanes* in Ontario (7). These races are morphologically extremely similar and yet one is diploid and the other is tetraploid without multivalent pairing at meiosis. If the latter is an autotetraploid with four identical genomes as it appears on morphological grounds, then why are only bivalents formed? It would seem that the tetraploid has become effectively "diploidized." A similar situation to this was found to be present in *Pellaea ternifolia* which had both diploid and tetraploid sexual races which formed only bivalents at meiosis (8).

It should be stressed that all hybrids found in the wild are given parentage on the basis of their intermediate morphology between putative parents. The interesting plant (Wagner 9434) assigned to *D. "dilatata"* (Lake Superior diploid) × *D. intermedia* is described by Wagner and Hagenah (4) cursorily as an intermediate, and one has no

way of knowing whether it is the result of an average or typical Lake Superior diploid × an average or typical *intermedia*, or for that matter whether it could not be an atypical *intermedia* × an atypical *D. marginalis*. A further possibility is that this plant (Wagner 9434) is a hybrid of a glandular Lake Superior "*dilatata*" × *marginalis*, since the illustrations of the authors' look similar. The point is, that nothing is known of the characteristics of the parents except as they are represented in the hybrid. In this case, "the leaf form was intermediate" although "the previous year's leaves were green and persistent."

The morphological data given by Wagner and Hagenah (4) for the western diploid is extremely scanty. There is no mention of the number of specimens examined or where they might have been from. The findings are summarized in six lines and concern such variable features as petiole scales and leaf blade shape.

The authors (4) disregard the plant geographical evidence. One can assemble quite an impressive array of species in the Lake Superior basin that are of Cordilleran affinities. Stebbins (9) lists ten species found even further east in the Bruce Peninsula, Ontario, that may be considered Rocky Mountain types. Butters and Abbe (10) list four western American types in a table of 70 rare species found in Cook County, Minnesota. Among the ferns of the Lake Superior basin, *Cystopteris montana*, *Woodsia scopulina*, and *Cryptogramma crispa* are considered to have western affinities.

Accordingly, when the geographical, morphological and cytological evidence is reviewed critically, one can only conclude that the western diploid, *D. dilatata (D. assimilis)*, and the Lake Superior diploid, *D. dilatata (D. spinulosa* var. *americana)* have not as yet been shown to be distinct and separate species.

Concerning the eastern tetraploid, *D. campyloptera* Clarkson, Wagner and Hagenah (4) suggest that this might be an allotetraploid of *D. intermedia* × Lake Superior diploid. An alternative suggestion that it is an ancient autotetraploid of the Lake Superior diploid which in turn is a diploid "*D.*

dilatata" (D. assimilis) cannot be disregarded on the available evidence. *D. campyloptera* which now forms only bivalents could be analagous to the tetraploid race of *Asplenium trichomanes.*

One is confronted in *Dryopteris* with the larger problem of what is a species? Wagner is a proponent of biological species, but critical criteria for separating species are few in the *Dryopteris spinulosa* complex. All the species are apparently able to cross with one another, consequently this is of little use as a limiting criterion, although much used for genome analysis. Morphology by itself, has so far failed to give a clear picture (e.g. Lake Superior diploid vs. *D. campyloptera* of the Appalachians). Instead, the practice is to return to the morphological evidence after the cytogenetic analysis is completed. Geographical distribution is of value to delimit a sexually interbreeding natural population even though the boundary between species is often obscured by disjunct ranges such as the amazing one shown by *Polystichum scopulinum.* Also with some calcicolous species of ferns, it may well be, that distribution is limited by lack of suitable habitats e.g. some Woodsias. Cytology has been extremely useful, but it is felt that too much emphasis on the criterion of homology, when so little is known about the true nature of pairing and chiasma formation at zygotene of meiosis, is apt to lead to false conclusions. — DEPARTMENT OF BOTANY, ONTARIO AGRICULTURE COLLEGE, GUELPH, ONTARIO, CANADA.

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ON PINGUICULA MACROCERAS LINK IN NORTH AMERICA

S. JOST CASPER

Link, 1820, described a new species of Pinguicula under the name *P. macroceras*, based on a sheet collected by Pallas in Unalaschka and later on preserved under no. 422 in the herbarium of Willdenow at Berlin. Reichenbach (1823) gave a picture of *P. macroceras* in his "Icones" (tab. LXXXII, fig. 169-170) ; but Chamisso (1831) demonstrated that it represented his own *P. microceras*, a plant of Unalaschka too.

In Willdenow's herbarium existed two other specimens of *Pinguicula*, both collected by Pallas and first mentioned by Link (1820) under the names *P. camtschatica* and *P. daurica*. Ledebour (1847/49) was acquainted with this fact, but related the two specimens to *P. macroceras*, which should be "P. vulgari et leptocerati maxime affinis et vix diversa". Herder (1871/72) followed him, but asserted that *P. macroceras* would be only a big-flowering form of *P. vulgaris*!

Nowadays most botanists treat it as *P. vulgaris*, the Japanese writing *P. vulgaris* var. *macroceras* Herder, while only a few authors attribute the rank of species to *P. macroceras* (Rydberg 1917, 1922, 1954; Komarov 1930, 1951; Boivin 1948).

In several papers Hultén (1949, 1958, 1960) discusses the problem and says: "It is . . . hardly possible to separate them"— i.e. *P. macroceras* and *P. microceras* —"*specifically* from the European plant" — *P. vulgaris* — "although the length and form of spur and lips are very different in some cases". (Hultén 1958, 230). Recently Ernst (1961) relates *P. macroceras, P. camtschatica, P. daurica* and *P. microceras* to *P. vulgaris.*

In a former paper (Casper, 1962) I first gave an account of my own views on the point in question. Now further studies on specimens in American herbaria enable me to confirm the meaning of Boivin (1948, 220) who wrote: ". . . *P. macroceras* est certainement spécifiquement distinct du *P. vulgaris*".

According to Link (1820) *P. macroceras* is characterized by the following diagnosis: "scapo foliisque glabris, calcare turbinato corollae laciniis longiore".

Unfortunately the type-specimen of Pallas was lost during World War II at Berlin and therefore, is not available for comparative studies (cf. Hultén, 1960). But there is no doubt that the specimens collected later by several botanists at the same locality are equivalent to those of Pallas: their flowers are typically long-spurred, and the long spur is the main characteristic in the diagnosis of *P. macroceras* given by Link.

Tables 1 and 2 reproduce the quantitative analysis of the length of spur (SPL) and corolla (C-L). Dried material of *P. vulgaris* from all parts of its area with particular consideration of Scandinavian specimens and of *P. macroceras* from the American part of its distribution was measured. These tables show the exact numerical composition of the investigated material.

KEY TO P. MACROCERAS AND P. VULGARIS:

Corolla lobes of the lower lip subobovate-oblong, more or less covering each other, or at least touching; lower lip of the calyx split up to half of its length.

Length of the corolla (15) 18-27 (36) mm. (spur included), length of the spur (3) 6-9 (11) mm. .....
.....*P. macroceras* LINK var. *macroceras*

Length of the corolla (10) 14-22 (29) mm. (spur included), length

TABLE I: Length of the corolla (C-L)

mm	11	12/13	14/15	16/17	18/19	20/21	22/23	24/25	26/27	28/29	30/31	32	Summa
GK	1	2	3	4	5	6	7	8	9	10	11	12	
P. macroceras	1	2	17	14	33	63	82	86	72	25	9	2	416
s.l.	0,2	0,5	4,2	3,5	8,2	15,4	20,2	21,2	17,6	6,2	2,3	0,5	100%
P. macroceras	-	-	2	1	15	28	62	73	69	23	9	2	284
s.s.	-	-	0,8	0,4	5,4	10	22,1	26,1	24,5	8,3	1,6	0,8	100%
P. vulgaris	9	47	86	107	115	84	57	26	6	2	-	-	539
	1,7	8,7	16	19,8	22,4	15,5	10,6	4,8	1,1	0,4	-	-	100%

TABLE II: Length of the spur (SPL)

mm = GK	1	2	3	4	5	6	7	8	9	10	Summa
P. macroceras	10	19	26	26	36	51	99	100	41	11	419
s.l.	2,4	4,5	6,2	6,2	8,6	12,2	23,6	23,9	9,8	2,6	100%
P. macroceras	-	-	1	-	9	39	92	99	37	11	288
s.s.	-	-	0,4	-	3,2	12,8	32,2	34,5	12,6	3,8	100%
P. vulgaris	2	11	82	141	150	97	37	9	5	2	536
	0,4	2,0	15,3	26,4	27,9	18,1	6,9	1,7	0,9	0,4	100%

of the spur 1-3 (5) mm.; lobes of the lower lip of the calyx almost entirely separated. A plant relatively frequent on the Aleutian Islands. ..... *P. macroceras* var. *microceras* (CHAM.) CASPER

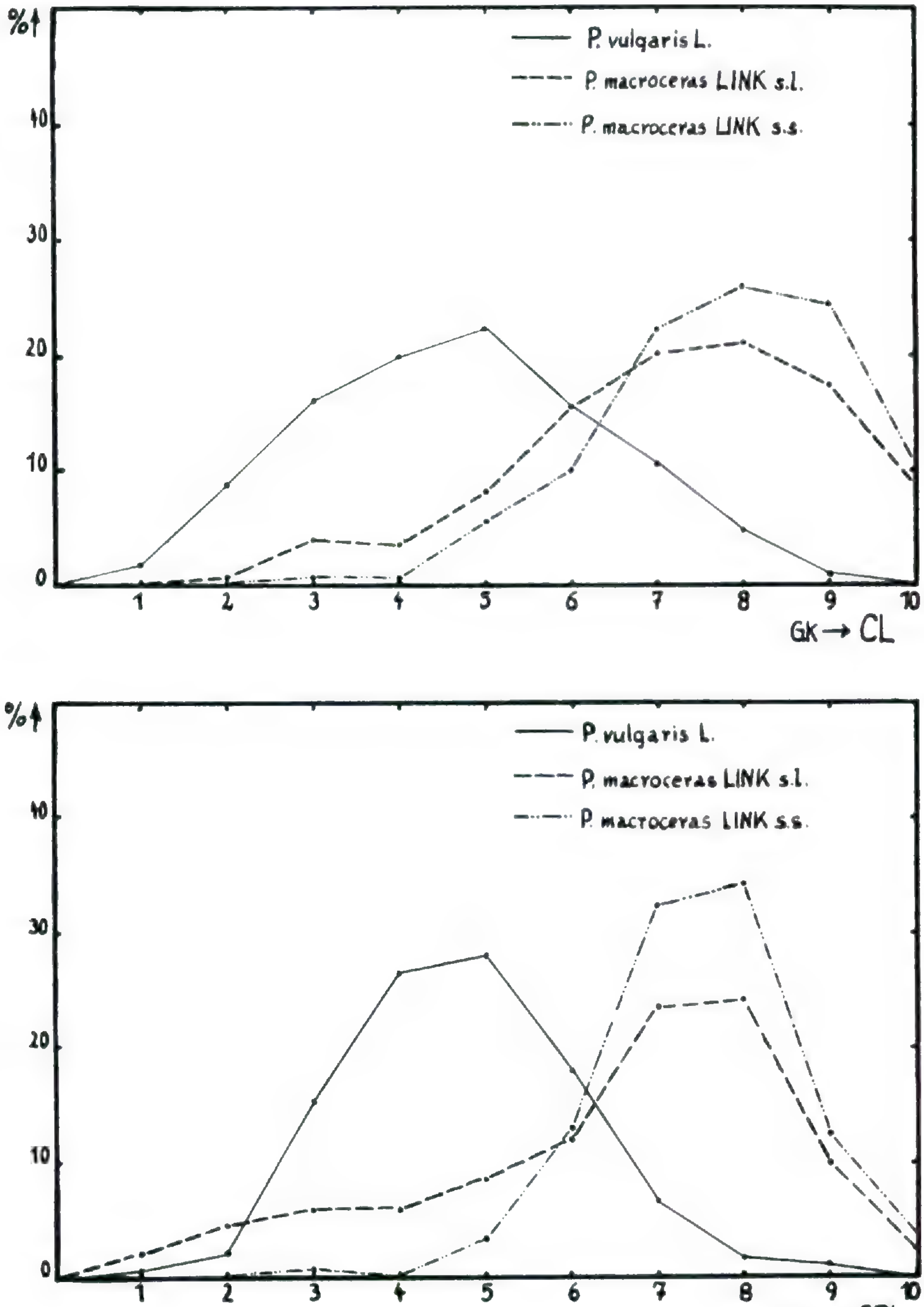
Corolla lobes of the lower lip oblong, not covering nor touching each other; lower lip of the calyx split up to 2/3 of its length; length of the corolla (10) 14-21 (29) mm. (spur included), length of the spur (1) 3-6 (10) mm. ..... *P. vulgaris* L.

It is at once apparent from a study of figure 1 that there is a really quantitative difference between *P. macroceras* and *P. vulgaris* with regard to the length of spur and corolla. Link, therefore, was right in characterizing *P. macroceras* as a species very different from *P. vulgaris* by means of the length of its spur. In *P. macroceras* the spur measures (1) 6-9 (11) mm., the corolla (15) 18-27 (36) mm. (spur included), in *P. vulgaris* the spur (1) 3-6 (10) mm., the corolla (10) 14-21 (29) mm. (spur included).

Other characteristics also distinguish *P. macroceras* from *P. vulgaris*. The typically obovate large, broad rounded lobes of the lower lip of the corolla of *P. macroceras* were seen already by Ledebour (1847/49), who enlarged Link's diagnosis by this data. In most cases the lobes more or less cover one another (fig. 2). As opposed to these facts the corresponding lobes of *P. vulgaris* have an oblong form and are distinctly separated from one another (fig. 3).

In *P. macroceras* the two lobes of the lower lips of the calyx are oblong and grown together only to the half of their length. *P. vulgaris* has a smaller calyx and the lobes of the lower lip are grown together to 2/3 of their length.

The geographical distribution of *P. macroceras* reaches from Japan and Kamtschatka over the Aleutian Islands to the Pacific coast regions of North America (Casper, 1962): the area of an amphi-pacific plant. The map (fig. 4) shows exactly the known distribution in North America. The records are based on the study of specimens in herbaria. From the Aleutians over Pacific-Alaska, British-Columbia, Alberta, Washington, Montana, Oregon its area extends south into Northern California (Del Norte County). The northern and eastern borders of the area are not sufficiently known. Further studies are necessary to clear up especially


%↑
P. vulgaris L.
P. macroceras LINK s.l.
P. macroceras LINK s.s.
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
GK → CL
%↑
P. vulgaris L.
P. macroceras LINK s.l.
P. macroceras LINK s.s.
40
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7
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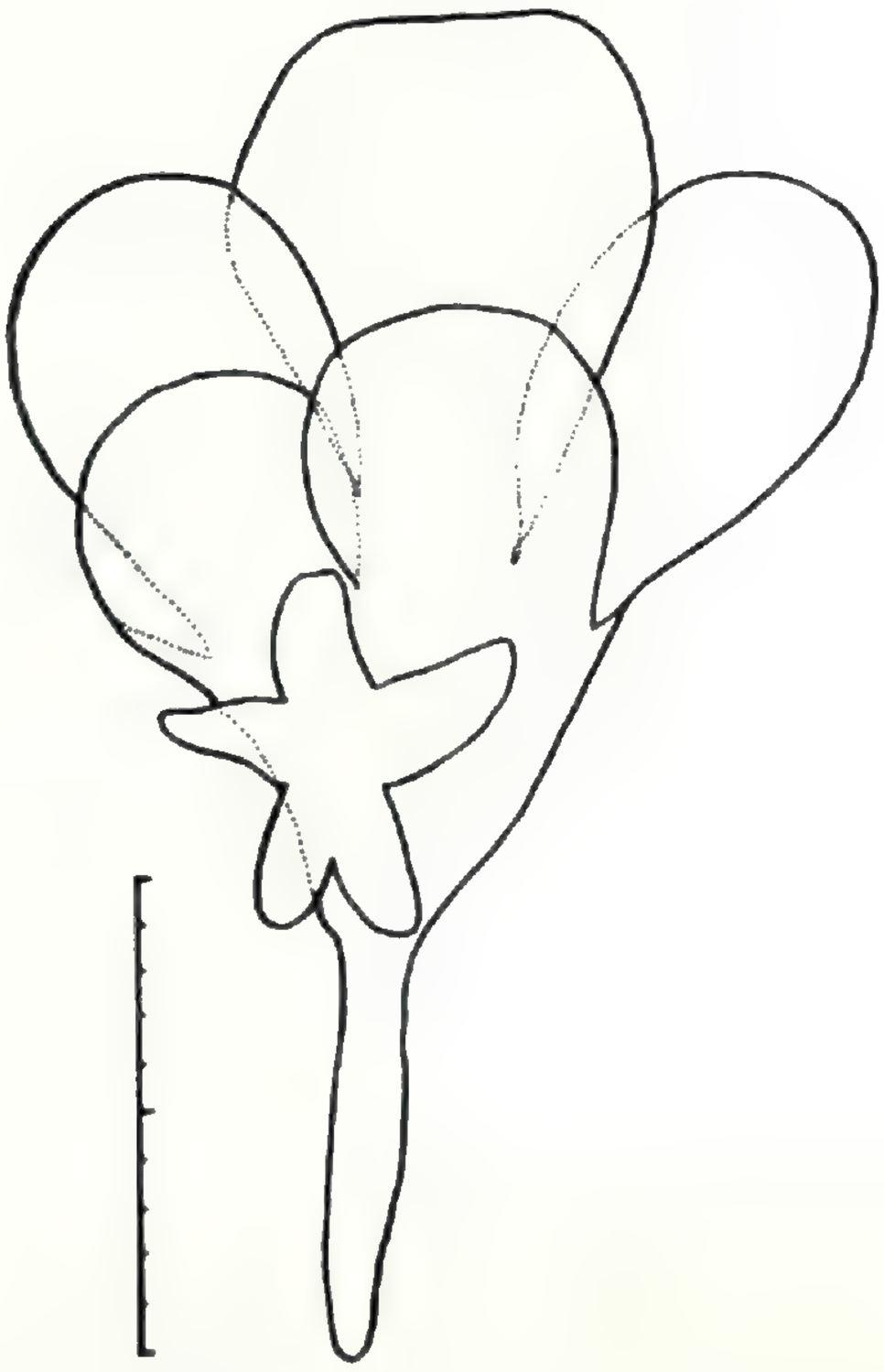
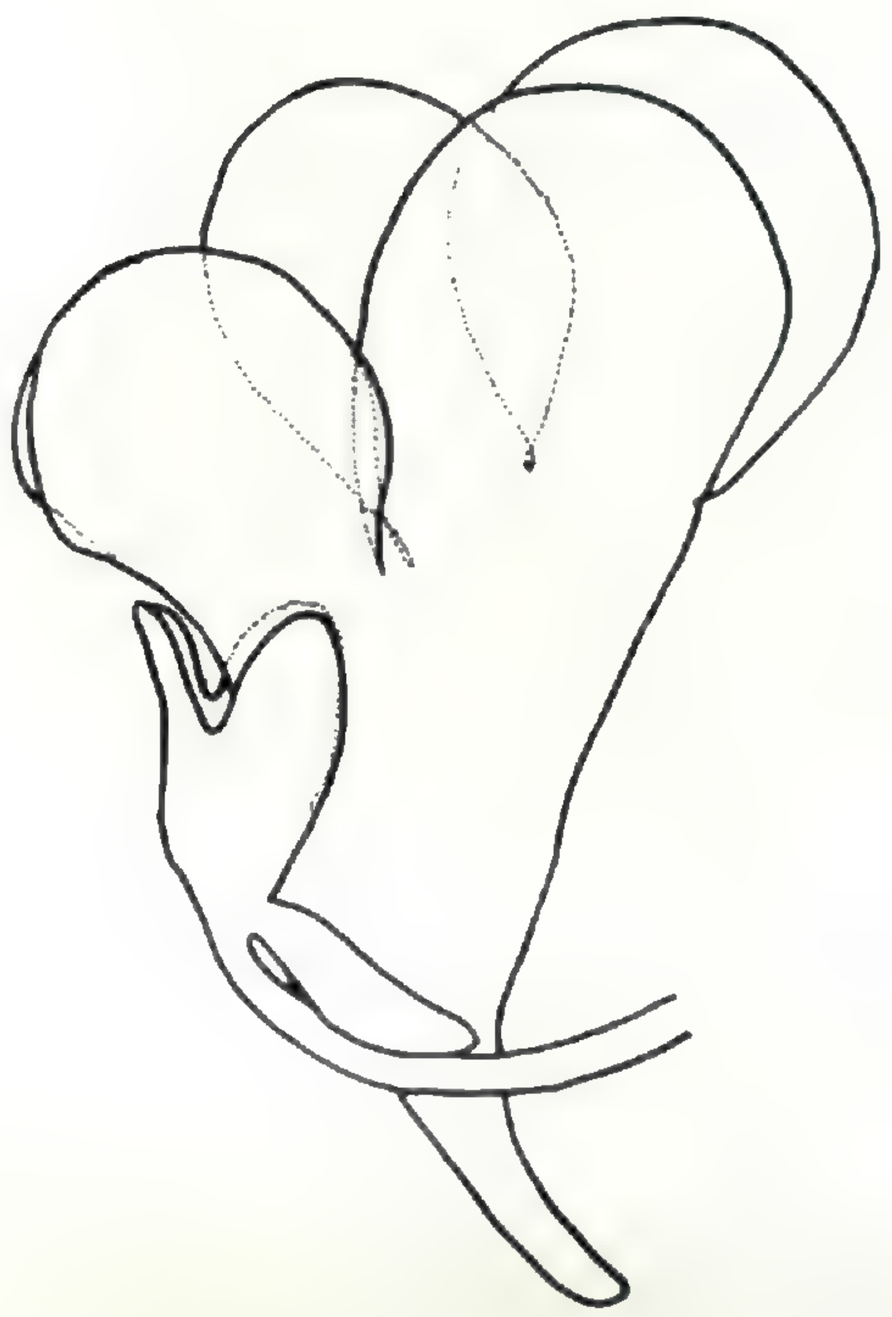
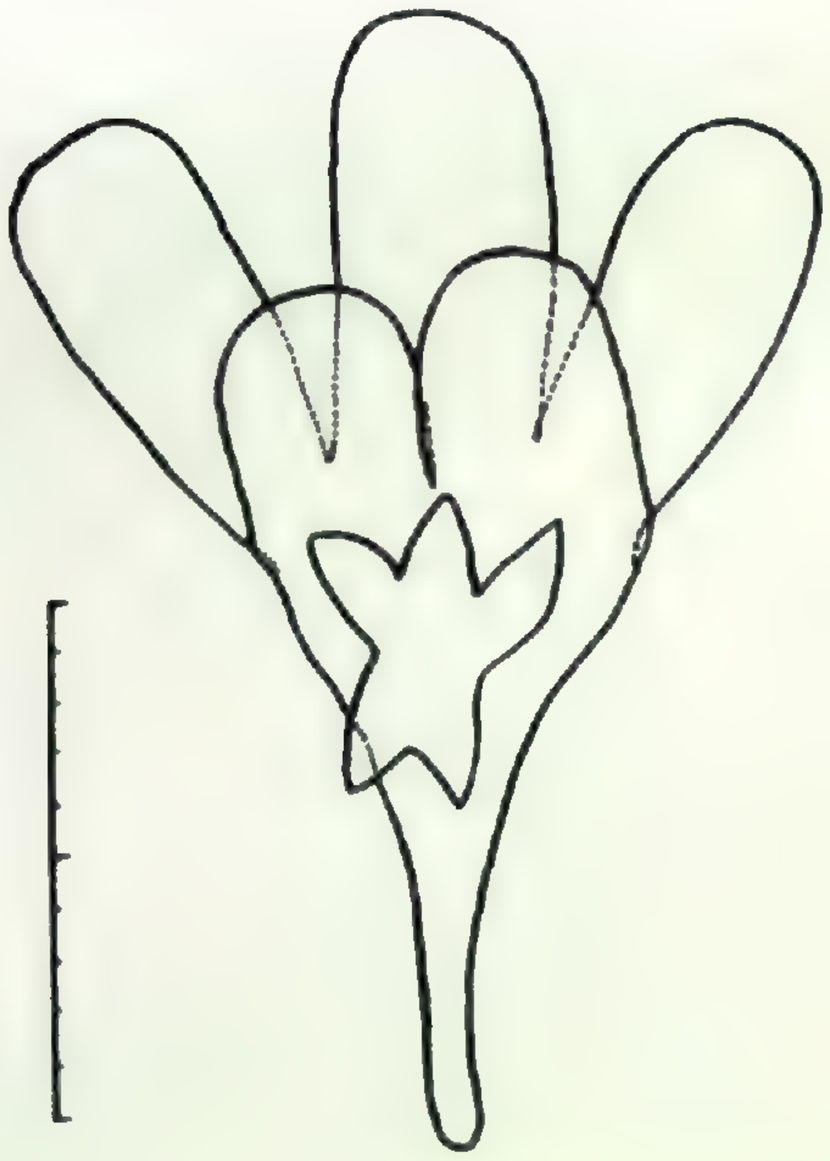
9
10
GK → SPL

Figure 1







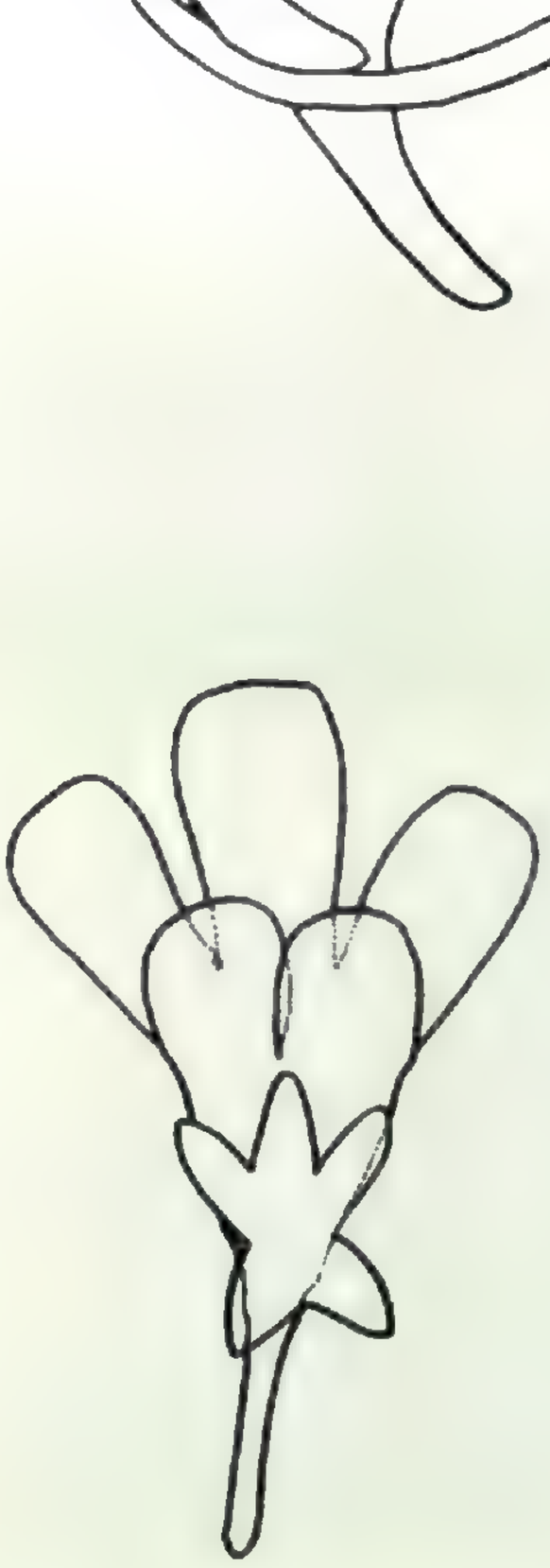


Figure 2 (above) Figure 3 (below)

the contact-zone with *P. vulgaris*, which is distributed in America from Labrador to Nome and Coronation Gulf, but is not known from the most eastern parts of Asia (Casper, 1962).

A peculiar problem is associated with the name *P. macroceras* Chamisso. The author described the plant as follows: ". . . species unalaschcensis alpina, nana, iam cornu brevi, laciniis corollae multo breviore . . ." (1831, 568). Mainly it was the small acute conical spur — the type specimen shows a spur of 1.5 mm. length — that induced Chamisso to separate his plant from *P. macroceras* or *P. vulgaris*. The other

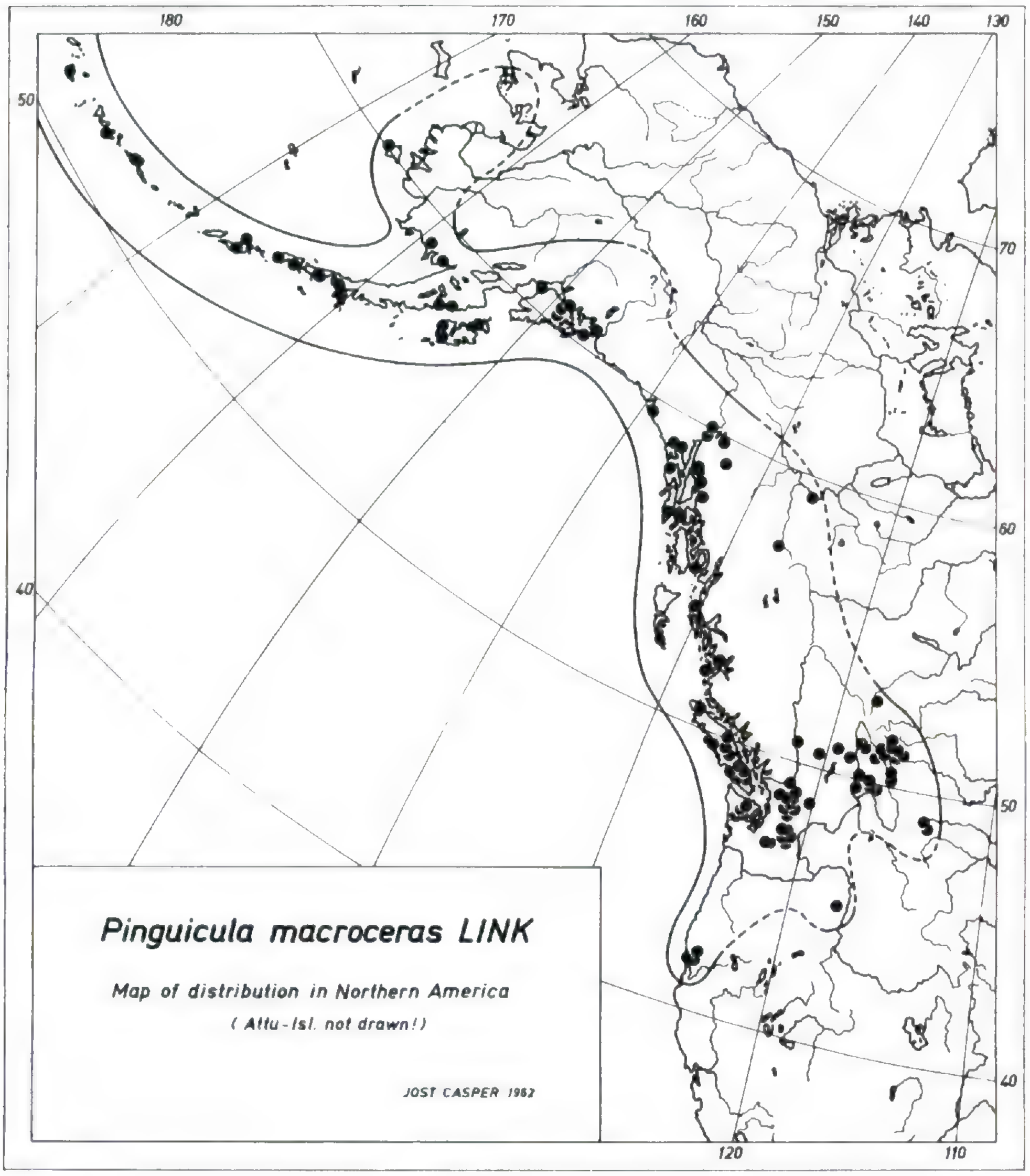


Figure 4

characteristics are similar to those in *P. macroceras*. Figure 1 shows two curves concerning *P. macroceras*. The first one — *P. macroceras* s.s. — excludes all *microceras* types from the Aleutians, the second one — *P. macroceras* s.l. — includes these types. It is apparent that in the case of *P. macroceras* s.l. the curve is depressed and displaced to the left by the *microceras*-material. But the particular character of the curve in relation to *P. vulgaris* is not changed.

Evidently *P. microceras* is a short-spurred form of *P. macroceras*, restricted to "the mountains and . . . arctic places, while *macroceras* types prevail more to the south" (Hultén, 1949: 1425; Casper, 1962). Already Chamisso (1831) understood *P. microceras* as "alpin" as opposed to the "subalpin-montanen" *P. macroceras*. Hultén (1949: 1425) is right in his statement, that "all the transitions exist between *P. macroceras* and *P. microceras*. But when he states that " . . . the same variation in the form and size of the flower can be observed in material of *P. vulgaris* from other parts of its range, for instance from Scandinavia . . ." he is mistaken as figure 1 shows. The curves confirm Hultén's own words: "It should be admitted, however, that plants approximating to the two extreme forms are more common on the Aleutians than they are in Scandinavia" (1960: 328). "All the transitions" concern only *P. macroceras* and *P. microceras*, but not *P. vulgaris*! The short-spurred microceras-type belongs to *P. macroceras* but never to *P. vulgaris*.

P. macroceras Link is a good species, sufficiently distinguished from *P. vulgaris* by its long spur, its obovate rounded lobes of the lower lip of the corolla and its deeply separated lobes of the lower lip of the calyx. Its area is typical amphi-pacific. Chromosome numbers are not known.

— INSTITUT FÜR SPEZIELLE BOTANIK DER FRIEDERICH-SCHILLER-UNIVERSITÄT JENA.

Records[1]

ALASKA. Aleutians: Adak Id. (CHI *1162067*), (DS *374181*). Amchitka Id. (US *173872*). Atka. Id. (MIN *355434*, DS *243871*). Attu Id. (MO *1705350*), Bassett Creek (MO *1304358*), Cape Khlebnikof (UC

[1]The list includes only half of the whole material studied.

730334). Kuiu Id., Washington Bay (MIN *530054*). Unalaska (UC *081604*), Iliuliuk Lake (UC *081605*). Kodiak Id.: Olga Bay (TRT *91769*), Red River, Alitak (US *220252*). Raspberry Id., Port Vita (MIN *525347*), Eagle River, Juneau (DAO *11226*) Hinchinbrook Id., Cordova (DS *150701*). Glacier Bay (UC *533512*). Yakutat (MO *822106*). New Metlakatla (MO *1764214*). Baranoff Id. (MO *1764215*). Muir Glacier (MO *1764216*). Chumagin Ids: Popoff Id. (MO *1764220*). Windham Bay (MO *17464221*).

BRITISH COLUMBIA. Log Cabin (V *12025*). Ogilvie Mts. (V *12225*). Prince Rupert (V *6330*). SW Gowgaia Bay (V *34881*). Goose Island (V *21541*). Vancouver Island: Mt. Splendor (V *11034*), Gordon River (MO *1764210*, DS *20540*), Port Hardy (UBC *23524*), Moat Lake (V *29750*), Forbidden Plateau, Meadow Lake Stream (V *15821*), Ucluelet (V *4586*), Henderson Lake (V *4584*), Mt. Joan (V *15910*), Cowichan Lake, N.E. shoulder Mt. Landalt (V *28690* + *28691*), Mt. Arrowsmith (V *22882*), Strathcona Park, Mt. Rooster Comb (V *10473*). Coast, Cypress Creek (UBC *24652*), Lillocet (V *5971*). Cheam (V *4588*). Fairmont H. Springs (V *13980*). Canal Flat (V *15343*). Kootenay, Gray Creek, Clarke's Pt. (V *12978*, UBC *5691*). Coast, Hollyburn Ridge (UBC *62839*), between Black Mt. and Hollyburn (DAO *11259*). Whistler Pass (UBC *5692*). Dam Mt., Goat Lake (UBC *5693*). Kaslo, White Water Mine (UBC *5694*). Haffner Creek, Marble Canyon Campground (DAO *11261*). Hat Creek Valley, Marble Mts. (WTU, herb. J. W. Thompson *17197*). Cassiar, Ingenika River (UBC *51290*). Tenquille Lake (UBC *83843*), Finch Ridge (UBC *48506*). Atlin District, Nakina Lake (DAO *11262*), Lake Atlin (UBC *51295*, UC *494021*). Yohs National Park, Emerald Lake (UBC *65608*), Twin Falls (MIN *267961*), Sorrent fan (MIN *241875*), Sir Donald Trail (MIN *241874*). Selkirk Mts., Lower Sandford Morains (MIN *241873*). Victor Lake, 11 mi. W. of Revelstoke (DS *352516*). Columbia Valley, Albert Canyon (UBC *74339*).

ALBERTA. Banff (V *26321*, DAO *11188*), Middle Springs (DAO *11190*), Sulfur Mt., (MIN *241872*), Bow River (DAO *11458*), Hillsdale Cabin (VT), between the Mistaya and Bow River Valleys (UC *707445*). Jasper, Lake Beauvert (TRT *124265*). Lake Louise (V *26323*). Selkirk Flora, Waterfall at gorge of Columbia (PH *526504*).

WASHINGTON. Olympic National Forest: Deer Lake (WTU *110683*), Heart Lake (WTU *33020*), Mt. Angeles (WTU, herb. J. W. Thompson *24361*), Mt. Colonel Bob Lookout (WTU, herb. J. W. Thompson). Mount Baker National Forest: Mt. Baker, Boulder Glacier (WTU *32274*), Mt. Baker Lodge, Bagley Lake (WTU, herb. J. W. Thompson *24361*), Mt. Hermon (UC), Skagit River Gorge, Newhalem (MIN *357710*), Skagit Pass (WTU *16083*), Mt. Higgins (UC *518084*), Baldy Peak (MO *1764206*). Mt. Rainier (MO *1764208*), Van Trump Park (WTU *88707*), Comet Falls (WTU *37612*), above Main Cowlitz Glacier (MO *1764204*). Kittitas Co.: Mt. Stuart (MIN *191336*), North Fork of Teanaway River, Wenatchee Mts. (BH *4453*), Iron Peak (UC

931294), Fish Lake (WTU *75350*, UC *710875*). Cascade Mts., Stevens Pass (UC *185022*). *Okanogan Co.*s *Horse Shoe Basin* (VT). Snohomish Co.: Mt. Dickerman (MO *1027818*), Columbia Peak, N of Monte Cristo (WTU *35468*). Yakima Region (UC *173684*).

MONTANA. Glacier National Park: N of Logan Pass (UC *028325*), Grinnell Lake (UCLA *40261*), Grinnell Falls (WTU *129482*), Iceberg Lake (CHI *953072, 953073*).

OREGON. Wallowa Co.: Ice Lake, bog (WTU, herb. J. W. Thompson *8179*), on trail from Wallowa River (ILL, herb. G. N. Jones *7497*). Josephine Co.: near Kerby (UC *76680*), other side of Tennessee Pass (MO *925823*).

CALIFORNIA. Del Norte Co.: French Flat, Gasquet, Smith River (UC *501348*), near Camps (MO *1261851*), Douglas Park, 9 mi. E of Crescent City (DS *179461*), Rock Creek Lodge (WTU *183910*).

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HOLOSTEUM UMBELLATUM L., AN ANGIOSPERM NEW TO MICHIGAN[1]

MARTIN A. PIEHL

In May 1958 I collected what I felt was an "unusual chickweed" at the then recently acquired 200-acre tract for the new University of Michigan Botanical Gardens on Dixboro Road, 4 miles northeast of Ann Arbor. After identifying this plant as *Holosteum umbellatum*, the jagged chickweed, I suspected it to be an interesting find since there were no Michigan specimens in the University Herbarium.

Several months later my attention was called to a specimen of *Holosteum* being accessioned by the herbarium. This collection was made at Ann Arbor in 1949 by the late L. H. Jordal (no. *1498*)[2], and appears to have been the first Michigan record. Whether or not Jordal realized that his collection was a record has not been determined, but the evidence at hand suggests he did not. In April 1961 I searched for Jordal's locality and found a good stand of *Holosteum* on cultivated soil in the general vicinity.

I have checked for records of this species in published local floras and at other herbaria in the state (see below). An additional collection was found in the herbarium of Eastern Michigan University, Ypsilanti, the specimens having been taken from the lawn near Pierce Hall on the campus of that institution by Richard A. Giles, 5 April 1955. I visited this site in May 1961 and found the plant both in lawn turf and in the adjacent open soil. Also, upon revisiting my original locality in 1960, 1961, and 1962, I found this species each year, and although actual numbers were not recorded, there appeared to be some increase in the number of plants. Specimens of each of my collections will be deposited in the University of Michigan Herbarium *(Piehl 5846, 6029, 6101, 6102)*.

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[1]The observations reported herein were made while the writer was engaged in doctoral studies in the Department of Botany, University of Michigan, Ann Arbor.

[2]It is of interest that this collection is from the old botanical gardens, a 40-acre tract on Iroquois Drive in Ann Arbor. However, it is very unlikely that the *Holosteum* was transported from that site to the new locality, since the transfer of the gardens' plants had not begun at the time of my collection.

Holosteum, a native of Europe, is well distinguished from our other chickweeds by its pale, generally glaucous foliage, its non-cleft but often jagged or emarginate petals, and by its umbellate inflorescence. Because some of the flowers open before the pedicels have elongated fully, the umbellate nature of the inflorescence may be obscure when flowering begins. The inflorence become distinctly umbellate later, however, and as has been recorded (Fernald, 1950), some of the pedicels actually become reflexed in fruit, although they are described by Britton and Brown (1897) as erect and are illustrated as such in the most recent edition of The Illustrated Flora (Gleason, 1952). None of the above manuals mentions the fact that the very delicate, somewhat hyaline, white or rarely pinkish petals are persistent, although they become hidden by the more rigid, scarious-margined sepals. A poorly-defined basal rosette is formed by large specimens, but it is lacking from the smaller plants. Although the stems tend to be somewhat decumbent, they are not trailing like those of some species of *Cerastium* and *Stellaria*.

I suspect that *Holosteum* is often overlooked due to its rather unusual phenology. It begins to flower in early April at Ann Arbor, and perhaps earlier depending on the season, but unlike the common chickweed, *Stellaria media*, it flowers and fruits for a relatively short time and is, itself, ephemeral. In early May I have observed both dehisced and developing capsules as well as flowers. By mid-May, however, the foliage yellows, and the entire plant soon dries and easily escapes detection. Thus, specimens of *Holosteum* are likely to be found over a period of only a few weeks, the plant apparently passing most of the collecting season in the form of seeds.

The precociousness of *Holosteum* caused me to doubt that the plant was, strictly speaking, an annual, as some of the manuals indicate (*e.g.* Gleason, 1952). During the winter 1961-62 I visited the Dixboro Road locality at a time when most of the snow had melted and found numerous seedlings which apparently had developed the previous autumn. *Holosteum* thus behaves as a winter annual. Whether some seeds also germinate the following spring is not known. The leaves

(not meaning the cotyledons) of the seedlings are spatulate or oblanceolate to oblong, the lamina narrowing in some cases nearly to the extent of making the leaves petioled, and some have a tiny black fleck at the very apex. They tend to have a thicker epidermal covering and to be more succulent than the leaves formed the ensuing growing season. The shape of the cauline leaves, in contrast, is from oblong to ovate, and they are sessile. The over-wintering leaves of the seedlings, which soon yellow and dry as growth is resumed the following spring, are not found on the majority of herbarium specimens, and are omitted from most descriptions. Elongation of the stem and the appearance of the inflorescence occurs rather rapidly and will take place at relatively low temperatures.[3]

The occurrence of *Holosteum* in southern Michigan indicates that its range is still being expanded, and that it should be looked for by early-ranging botanists elsewhere in the Midwest. Previous to the Michigan collections reported herein, the jagged chickweed was recorded as far west as Ohio and Kentucky by Fernald (1950), while earlier it was known at first only from the vicinity of Lancaster, Pennsylvania (Gray, 1856), and later from New Jersey and Pennsylvania to Georgia (Robinson and Fernald, 1908).

I wish to acknowledge the cooperation received from curators of the following herbaria: Cranbrook Institute of Science, Eastern Michigan University, Michigan State University, The University of Michigan, and Wayne State University. — SANTA BARBARA BOTANIC GARDEN, SANTA BARBARA, CALIFORNIA.

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[3]Specimens kept at a constant 40°F in March before spring growth had begun underwent elongation of the stems and enlargement of the flower buds.

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ROBINSON, B. L., AND M. L. FERNALD. Gray's new manual of botany, 7th Ed. American Book Co., New York.

TWO NEW SPECIES OF POLYGALA FROM NORTHERN MEXICO[1]

WALTER H. LEWIS

In an earlier paper on the cytology of *Polygala* (Lewis & Davis, Rhodora 64: 102-113, 1962), reference was made to five collections thought to represent four new species. Using the keys and descriptions of Blake (N. Am. Fl. 25: 305-370, 1924), species numbered 3 *(Oliver 136)* and 4 *(Lewis 5728, 5755)* could be placed with *P. alba* Nutt. and the var. *suspecta* Wats. The chromosome number of *P. alba* in Texas was reported as $n = 12$ whereas those for number 3 from Oaxaca and number 4 from Coahuila and Nuevo Leon were recorded as $n =$ ca. 36 and $n = 52$-54, respectively. Although wide differences in chromosome number are not unknown for a single species, these counts, when considered in conjunction with the known heteromorphism of individuals now included under *P. alba* (Dr. M. C. Johnston, University of Texas, personal communication), strongly suggest that more than one species is involved. Additional cytotaxonomic study should be completed, however, particularly with the Mexican forms in the complex, before the naming and describing of new taxa will be purposeful. Consequently, only those plants represented by numbers 1 and 2 will be presented.

Polygala shinnersii W. H. Lewis, sp. nov.

Caules e radice tenui perenni plures 1.5-2.0 dm. alti. Folia inferiora mediocriaque verticillata spatulato-obovata, suprema alterna linearia. Racemi cylindrici acuminati 6-8 mm. diametro; flores candida purpureo-cristati; sepala lanceo-elliptica 1.0-1.2 mm. longa; alae obovatae 2.9-3.3

[1]This study was supported by the National Science Foundation G-21818.
I am indebted to Dr. Lloyd H. Shinners, Southern Methodist University, for the translations to the Latin.

mm. longae. Capsulae ovales 2.6-3.2 mm. longae; semina pilosa 2.4-2.7 mm. longa, arillorum lobae duae linearo-ellipticae 1.6-1.8 mm. altae.

Stems several from slender perennial root, erect, angular, 1.5-2.0 dm. tall; leaves 4-6 in whorls to middle of stem or beyond, usually shorter than the internodes, spatulate-obovate, 6-13 mm. long, 2-3 mm. wide, the upper alternate, linear. cuspidate, 13-21 mm. long, 1.5-2.0 mm. wide, glabrous; peduncles 2.2-4.2 cm. long; racemes dense, cylindrical, acuminate, 6-8 mm. thick; pedicels 0.2-0.3 mm. long; flowers white with purple crests; sepals lance-elliptic, acuminate, 1.0-1.2 mm. long; wings obovate, 2.9-3.3 mm. long, 1.7-2.0 mm. wide; keels 2.7-3.0 mm. long, the crest of 4 lobes on each side; capsules oval, 2.6-3.2 mm. long, 2.2-2.6 mm. wide; seeds cylindrical, pilose, 2.4-2.7 mm. long, 1.2-1.5 mm. wide; arils 1.6-1.8 mm. high, the 2 linear-elliptic lobes appressed; chromosome number $2n$ = ca. 84.

Holotype: MEXICO: Nuevo Leon: 11 miles E of junction of Highways 57 and 60, *Lewis 5754* (US). Rare in open pine woods, 2 Sept. 1961. Known only from the type locality.

Although keying to the section *Timutua, P. shinnersii* is not closely related to other species in the section. In habit it has a striking resemblance to that of *Galium.*

Polygala vergrandis W. H. Lewis, sp. nov.

Caules e radice annua plures puberuli 3-8 cm. longi. Folia alterna linearia. Racemi cylindrici acuminati 2.5-4.0 mm. diametro; flores candida viridi- et purpureo- venosi; sepala lanceo-elliptica 1.0-1.5 mm. longa; alae obovatae 1.8-2.2 mm. longae. Capsulae oblongae 2.5-3.0 mm. longae indehiscentes loculo superiore alato inferiore exalato; semina pilosa 2.0-2.4 mm. longa, arilli 0.6-0.9 mm. alti, lobis duabus appressis (in seminibus e loculo inferiore deficientibus).

Stems several from a long slender annual root, 3-8 cm. long, erect or ascending, slender, densely puberulous; leaves alternate, linear, 4-8 mm. long, 1 mm. wide, acuminate at apex, 1-nerved below, margins somewhat revolute; peduncles 3-6 mm. long; racemes cylindric, acuminate, dense, 2.5-4.0 mm. thick, the axis 10-15 mm. long; bracts lanceolate, deciduous, 1.0-1.3 mm. long; pedicels 0.3-0.5 mm. long; flowers white, green- and purple- veined; sepals lance-elliptic, subacuminate, 1.0-1.5 mm. long; wings obovate, 1.8-2.2 mm. long, 0.6-0.9 mm. wide, obtuse at apex; keels 1.6 mm. long, the crest of 2 lobes on each side; capsules oblong, rounded at both ends, light green, 2.5-3.0 mm. long, 1.2-1.5 mm. wide, the upper cell larger, winged, the lower wingless, indehiscent; seeds cylindrical, curved, pilose, 2.0-2.4 mm. long, 0.5 mm. wide, seeds of lower cell somewhat smaller; arils 0.6-0.9 mm. high, 2 lobes appressed, wanting in seed from lower cell; chromosome number $2n = 24$.

Holotype: MEXICO: Nuevo Leon: 9.9 miles E of junction of Highways 57 and 60, *Lewis 5746* (US). Rare on rocky edge of hill, 2 Sept. 1961. Known only from the type locality.

Characteristics of the section *Monninopsis* nearest *P. scoparioides* Chod., but the resemblance to this species is not close. — STEPHEN F. AUSTIN STATE COLLEGE, NACOGDOCHES, TEXAS.

THE AQUATIC FORM OF *ALISMA SUBCORDATUM* Raf.

RICHARD W. RHOADES

Alisma subcordatum is a common species of marsh or aquatic herb of temperate North America and usually grows emersed with ovate or eliptical aerial leaves. In the fall of 1958 a botany class at the University of New Hampshire collected a specimen growing in 1½ feet of water which had narrow-lanceolate floating leaves. Subsequently other plants with floating leaves were collected in the vicinity of Durham, N. H. While a deep water form of the European *Alisma plantago-aquatica* is recognized (Arber 1920, 1925), apparently most authors do not recognize a similar form in the American species. Muenscher (1944), Fassett (1957), Fernald (1950) and Hendricks (1957) do not mention a deep water form, but Pierce (*In* Gleason 1952, vol. 1, p. 88) states that plants growing in relatively deep water or where the water level varies have longer, laxer, ovate-lanceolate to linear leaves.

The following experiments were conducted in the greenhouse to test the response of plants to varying depths of water. Seeds were stratified at 5° C. for 60 days according to the recommendations of Crocker and Barton (1952), and were then germinated in sand under water. On April 1 the seedlings were transplanted to muck soil in battery jars, about 20 seedlings per jar. The water levels were adjusted to 2 cm (10 jars), 12 cm (4 jars) and 25 cm (2 jars). Nothing more was done to the plants except to maintain the water level. By early July, four to six plants in each jar with 2 or 12 cm of water had produced aerial leaves and inflorescences In addition, the plants grown in 12 cm of water produced floating leaves. Plants grown in 25 cm of water, however, produced only floating leaves.

During the course of development from seedling to flowering stage, *Alisma subcordatum* produces three types of leaves. Seedlings possess a cluster of several gramineous, primary leaves, 3-5 cm in length which are usually submerged. As the plants mature they next produce petioled, narrow-lanceolate, juvenile leaves. If emersed, the later juvenile leaves develop into ovate, aerial leaves, but if submersed, the later juvenile leaves retain their narrow form, the petioles elongate, and the blades float on the surface of the water.

The next phase of the experiment was designed to test the effect of a raised water level on the development of plants which previously had been grown in shallow water. Four of the ten jars which had been maintained at the 2 cm level were used. The water level was raised to 25 cm in two of these. Inflorescences were removed from the plants in one of these jars and also from the plants in one of the jars with 2 cm of water. The status of each jar was then as follows:

No. 1 25 cm water; inflorescences not removed
No. 2 25 cm water; inflorescences removed
No. 3 2 cm water; inflorescences not removed
No. 4 2 cm water; inflorescences removed

A month later the plants in jars 1 and 2 had produced only floating leaves. Those in jar 2 also produced reduced inflorescences. The plants in jars 3 and 4 produced new aerial leaves and new inflorescences.

The plants which had been grown continuously in 12 cm of water produced aerial leaves, floating leaves and flowers throughout the summer. Plants growing in 25 cm of water from the beginning produced only floating leaves during the entire period of observation.

Similar observations on the growth of *Alisma plantago-aquatica* have been made by Arber (loc. cit.). This species also commonly occurs in shallow water and produces aerial leaves. The aerial leaves are preceded by submerged, "band-shaped", primary leaves and usually by "swimming leaves" as well. In moderately deep water, only submerged and "swimming leaves" are produced. These "swimming leaves"

appear to be equivalent to the juvenile or floating leaves observed in the present study.

The plants used in this experiment were the smaller-flowered, more southern species *Alisma subcordatum*. Although not recognized very widely by botanists, the aquatic form of this species probably occurs rather commonly. This experiment has shown that plants of *Alisma* have the ability to produce floating leaves if submersed at any time during their period of development.

Specimens cited: in 1 to 1½ feet of water, old reservoir, Durham, Strafford County, N. H. R. W. Rhoades and A. R. Hodgdon. 16 Oct. 1958 (NH); in 2 feet of water, Hepler's Pond, Madbury, Strafford County, N. H. R. W. Rhoades. 1 Nov. 1959 (N.H.).

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MAZUS REPTANS (SCROPHULARIACEAE) IN MARYLAND. — *Mazus reptans* N. E. Brown, Bot. Mag. t. 8554, 1914, is a freely stoloniferous, mat-forming perennial with flowers half again as large as those of the non-stoloniferous, annual *M. japonicus* (Thunb.) Kuntze. The latter species is the only one hitherto reported as wild in the

United States, first by Small in the second edition of his *Flora of the Southeastern United States* (1913, p. 1365, as *M. rugosus*), from southern Louisiana. It is not mentioned in his *Manual of the Southeastern Flora* (1933). In Pennell's *Monograph of the Scrophulariaceae of Eastern Temperate North America* (Phila. Acad. Monog. **1**: 137, 1935), it is cited from Pennsylvania, the District of Columbia, and Oregon as well as Louisiana. More recently Fernald (*Gray's Manual*, 8th ed., p. 1275, 1950) reports it from "Pa. to Mo. and La.; Pacific Slope," and Gleason (*The New Britton & Brown Illustrated Flora* 3: 215, 1952) says "cultivated for ornament and tending to escape in lawns," without locality. Gleason's description of it as "a creeping perennial" and "cultivated for ornament" cannot apply to *M. japonicus*. Dr. Arthur Cronquist informs me that the New York Botanical Garden has a specimen of *M. reptans* "as a lawn weed on the Cornell campus in Ithaca," New York, evidently the basis for Gleason's remarks. It can now be reported that *M. reptans* is genuinely naturalized in MARYLAND, Calvert Co.: moist clay cliffs with *Liquidambar Styraciflua* & *Cryptotaenia canadensis*, Scientists' Cliffs, District No. 1, *Frank C. Seymour 16,697*, 24 July 1946 (SMU). "Forming a mat in dense shade." Plant past flowering. This species is not treated in Hui-Lin Li's "The genus *Mazus* (Scrophulariaceae)," Brittonia 8: 29-38, 1954; his revision actually treats only species known from China. Brown says that the plant comes from the Himalayas. Presumably it is confined to the eastern portion, since the account of the genus in Pennell's *The Scrophulariaceae of the Western Himalayas* (Phila. Acad. Monog. 5: 33-35, 1943) does not include it.

Plants of *M. reptans* received from Rocknoll Nursery, Morrow, Ohio, in late March, 1961 (in bloom on arrival), survived in my yard in Dallas, Texas, to bloom again in the spring of 1962, with more deeply colored and showier corollas than the previous year. They are growing in calcareous clay in shade, and require constant watering during our hot, dry summers. N. E. Brown spoke of it as flowering "almost continuously from early spring to late autumn" under cultivation in England, but that is not the case under Dallas con-

ditions. It is surviving a second summer here (July, 1962), but like last year shows no sign of blooming after the spring season. The potential area which this species may occupy is evidently very great. It should be watched for as an escape elsewhere in the United States and southern Canada.

Mazus japonicus is an annual weed which, like several others, both alien and native (e.g. *Cardamine pennsylvanica, Stachys floridana, Youngia japonica*), is being spread all through the South in shipments of ornamental shrubs, especially azaleas and camellias. There are specimens in the SMU Herbarium from Alabama (Baldwin Co.), Arkansas (Clark Co.), Florida (Liberty Co.), Louisiana (Lafayette, Ouachita, and St. Tammany parishes; Pennell knew it from East Baton Rouge and Orleans parishes), and Texas (Dallas, Harrison, and Jefferson counties). The Dallas plants seem to have been killed out by the abnormally severe winter of 1961-1962, with repeated severe freezes (down to 17° F.), but further observation will be needed to confirm this. — LLOYD H. SHINNERS, SOUTHERN METHODIST UNIVERSITY, DALLAS 22, TEXAS.

STUDIES IN THE GUTTIFERAE. II. TAXONOMIC AND DISTRIBUTIONAL OBSERVATIONS ON NORTH AMERICAN TAXA[1]

PRESTON ADAMS[2]

This contribution is a miscellany of observations which have accumulated during recent studies of the *Guttiferae* in North America. Included are comments on the delimitation of the *Guttiferae*, a re-evaluation of the generic status of *Sanidophyllum* Small, the relegation to synonymy of a few specific epithets, some notes on geographic distribution of

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several species, and a brief survey of some of the systematic problems discernible in the family.

DELIMITATION OF THE GUTTIFERAE

The Englerian concept of the *Guttiferae* as comprising five subfamilies is being followed in my studies. Some recent authors, including Lawrence (1951) and Hutchinson (1959), have split the group into two families, elevating Engler's *Hypericoideae* to the familial level *(Hypericaceae)*. This restricted concept was used by me in earlier studies (Adams, 1957, 1959). Recent investigation of the relevant genera by Dr. Norman K. B. Robson at Kew strongly suggests that a re-evaluation of the claim of the *Hypericaceae* to family rank is necessary (Robson, personal communication). I agree with Dr. Robson that if Engler's *Hypericoideae* is elevated to the family level then it would appear that the other four subfamilies must be made into families also. This is clearly undesirable because of the close interrelationship which these groups appear to have with one another. The *Hypericoideae* seem to be related to the *Calophylloideae* and to the *Clusioideae* through *Hypericum* (Lawrence, 1951; Robson, personal communication). The other members of the *Hypericoideae* are *Triadenum* (eastern North America and Japan), *Vismia* (tropical America), *Cratoxylon* (Indomalaysia), *Eliaea, Psorospermum, Endodesmia,* and *Haronga.* (The last three genera are native to tropical Africa and/or Madagascar.) One of Small's generic segregates, *Sanidophyllum*, of southern Florida, U. S. A., is best included within *Hypericum* (see below).

RE-EVALUATION OF THE GENERIC STATUS OF SANIDOPHYLLUM

The genus *Sanidophyllum* was established by Small in 1924 to accommodate a single species, *S. cumulicola* Small. Plants of this taxon are wiry herbaceous perennials which grow in the *Pinus clausa* scrub in Highlands Co., Florida. Commonly, several stems arise from an elongated taproot near or just below ground level. The stems die back to ground level each winter but the rootstocks survive for several years. New growth each spring is due to the forma-

tion of young shoots from these rootstocks. On the juvenile stems the leaves are densely crowded and tend to be more or less closely appressed, the whole presenting a striking bryoid appearance. As the stems elongate the internodes become much longer at successively higher levels. Much of the photosynthetic function is apparently carried on by the stems since the leaves are greatly reduced in size compared to other *Hypericum* species, excepting *H. gentianoides*. The slender, sharply ascending stems with their tiny scale-like leaves suggested to Small a species of *Cathartolinum (Linum)*.

Recent intensive studies of the floral anatomy and taxonomy of *Hypericum* and several of the generic segregates (Robson, 1956; Adams, 1962) have demonstrated that a re-evaluation of the status of these groups is necessary. While the anatomy of the flower in *Sanidophyllum cumulicola* has not been investigated, comparative morphological study of these plants as well as their relatives in *Hypericum* Sect. *Brathys* strongly suggests that this species represents merely an extreme evolutionary development within this section of *Hypericum*. Morphological features common to *Sanidophyllum* and certain species of *Hypericum* (especially many of those in Sect. *Brathys*) include perennial habit, much-reduced scale-like leaves which lack an articulation at the base, clear glands in the leaves, sepals, and young stems, 5 slightly unequal sepals which are non-articulated at base, 5 slightly asymmetrical yellow petals whose withered remains persist long after anthesis, long-persistent stamens, 3 filiform-elongate styles which are seperate to the base and somewhat spreading at anthesis, capitate stigmas, 3-carpelled gynoecium, parietal placentation, and dark brown seeds with a finely reticulate testa.

In its morphology as well as its ecology *Sanidophyllum cumulicola* seems to be most closely related to *H. gentianoides* (L.) BSP, a plant found over much of eastern United States. The leaves of both are considerably reduced in surface area, with those of the latter species being noticeably smaller than the former. Plants of both species possess slender wiry stems; those of *H. gentianoides* are often much-

branched, presenting a bushy appearance in contrast to the relatively few-branched aspect of *S. cumulicola*. The widespread *H. gentianoides* is an annual, even in peninsular Florida, while the very local *S. cumulicola* is definitely perennial. The inflorescence in both species is basically dichasial, the pattern typical of *Hypericum*. The flowers of *H. gentianoides* are considerably smaller in size than those of *S. cumulicola*. All these features suggest a fairly close relationship.

Both of these plants are adapted to dry habitats. *Sanidophyllum cumulicola* grows in the sand of the scrub in association with *Pinus clausa, Paronychia pulvinata, Polygonella basiramia, Prunus geniculata, Ceratiola ericoides*, and other species. It is most abundant in "blow-out" areas where the moisture is more abundant and the competition from other sand scrub species is less severe. *Hypericum gentianoides* also grows in sandy soil, often becoming very abundant in turkey oak-pine scrub (especially following clearing by man), fallow fields, moist hollows in coastal dunes, rock outcrops, and roadside embankments. Both of these species are closely related to *H. drummondii* (Grev. & Hook.) T. & G., a plant of the southern United States.

Sanidophyllum cumulicola is related, although much less closely, to *Hypericum fuertesii* Urb. of Hispaniola. Plants of this West Indian species have much-reduced leaves which are strongly ascending and crowded. The inflorescence of *H. fuertesii* is much less floriferous, however, and is often reduced to a 3-flowered dichasium or even a single flower. It is an inhabitant of high elevations (6,000-8,000 feet) while *S. cumulicola* grows at only a few hundred feet. Other relatives of this species comprise the *H. pauciflorum* complex in Mexico and Central America (see below).

The reduction of *Sanidophyllum* to *Hypericum* makes necessary the following combination:

Hypericum (Sect. **Brathys) cumulicola** (Small) P. Adams, *comb. nov.*, based on *Sanidophyllum cumulicola* Small, Bull. Torrey Club 51:391. 1924.

The limited distributional area of this species is being diminished at an alarming rate. The sand scrub lands of central and southern Highlands County, Florida, are rapidly

succumbing to the bulldozer and the citrus grove. Studies of the ecology and cytology need to be made before the species becomes extinct.

TAXONOMIC NOTES

Hypericum aphyllum Lundell, Am. Midl. Nat. 29:477. 1943. TYPE: British Honduras, Toledo District, Monkey River, near Jenkins Creek, *Gentle 4175* (Holotype, MICH, not seen; isotype, GH).

Lundell distinguished this species from *Hypericum gentianoides* (L.) BSP, a plant of eastern United States, primarily on seed characters. The seeds of *H. aphyllum* were said to be shorter and the testa smoother than in *H. gentianoides*. Also, the number of seeds per capsule is twice that of *H. gentianoides*, according to Lundell. Two specimens from Florida were assigned to the new species also. My examination of many collections of *H. gentianoides* from throughout its range indicates that seed characteristics are highly variable. There is a tendency for the seeds to be shorter and the testa smoother in specimens from the southern portion of the range, with those of some collections (e.g. those cited by Lundell and others) much resembling those of *H. aphyllum*. Study of an isotype of that species strongly suggests that, upon consideration of the entire morphology of the plant, the claim of *H. aphyllum* to specific status is highly questionable. Dr. A. J. Sharp wrote upon the isotype sheet in 1950 that *H. aphyllum* is "doubtfully distinct" from *H. gentianoides*. I think that a thorough analysis of seed variation within the latter species ought to be made before recognizing the British Honduran plant as a separate taxon.

Hypericum pringlei Watson, Proc. Am. Acad. 25:143. 1890. TYPE: Mexico, Nuevo Leon, Sierra Madre, near Monterey, *Pringle 3012* (GH).

The type specimen of *H. pringlei* compares readily with numerous specimens of *H. perforatum* L. from western United States as well as from other regions. In my opinion Watson's species is conspecific with *H. perforatum*.

Hypericum terrae-firmae Sprague & Riley, Kew Bull. page

12. 1924. TYPE: British Honduras, *Peck 321* (Holotype, K, not seen; isotype, GH).

Sprague and Riley noted that their *Hypericum terrae-firmae* is "the representative on the mainland of the Cuban *H. styphelioides* A. Rich." However, they made no mention of the features which they used to separate the mainland plant. An isotype of *H. terrae-firmae* is hardly distinguishable, if at all, from many Cuban specimens of *H. styphelioides*, a species originally described in 1845 (Ess. Fl. Cuba. 237). Although the Cuban plants exhibit considerable variation, especially in leaf size and shape, I am unable to find any basis for taxonomic segregation of the Honduran specimens. I first questioned the claim of *H. terrae-firmae* to recognition in 1959 while doing casual study of the West Indian-Central American specimens of the genus at the Gray Herbarium. Recently, Dr. Louis O. Williams has independently arrived at the same conclusion, judging from his annotation of the isotype at the Gray Herbarium. It seems clear, therefore, that the plant of British Honduras can be readily assigned to the earlier-named *H. styphelioides*.

NOTES ON GEOGRAPHIC DISTRIBUTION

Since the publication of distribution maps for the species in the generic segregate *Ascyrum* (Adams, 1957) some noteworthy range extensions or corrections have come to my attention. These species were transferred to *Hypericum* by Adams and Robson (1961).

HYPERICUM STRAGULUM Adams & Robson (*Ascyrum multicaule* Michx.). Mr. W. E. Buker, an associate of the Carnegie Museum in Pittsburg, Pennsylvania, has written me that plants of this species have been collected in several counties of southwestern Pennsylvania. These collections (not seen by me) include the following: Bedford Co., south of Silver Mills, *Henry & Buker* 5/19/51; Fayette Co., Ohiopyle, *Shafer* 9/1/01, and *Bright* 9/6/1915; Greene Co., 1.5 miles east of Mt. Morris, *Beer, Henry & Buker* 8/8/51. All of these specimens are in the Herbarium of the Carnegie Museum, according to Mr. Buker.

At the time I published the revision of *Ascyrum* men-

tioned above, *Hypericum stragulum* was not known to grow in South Carolina. In September of 1958 I collected it five miles northwest of Walhalla in Oconee County (*Adams 160*, FSU). Diligent search in adjacent counties will do doubt reveal other stations.

HYPERICUM HYPERICOIDES (L.) Crantz (*Ascyrum hypericoides* L.). The disjunction in range which was thought to exist (Adams, 1957) in Mexico between southern Nuevo Léon and eastern Hidalgo, a distance of some 300 km, has been virtually eliminated by two recent collections. A station in the state of San Luis Potosí, about 50 miles east of the city of that name, was reported by Rzedowski & Rzedowski (1957). Plants of this species have been collected also in the state of Tamaulipas about 40 miles north-northwest of Aldama (the Sierra de Tamaulipas range) by Dr. R. L. Dressler (*2408*, GH).

SPECIES COMPLEXES REQUIRING INTENSIVE STUDY

During recent studies of North American *Hypericum* I have become aware of several taxa which are in need of critical evaluation. I believe that a brief discussion of these groups will be of interest, especially to the workers currently engaged in floristic studies. This is presented with the hope that other botanists, especially graduate students in search of thesis problems, will be enticed to study these plants. In addition, the naming of new taxa, especially in Mexico, is discouraged until thorough knowledge of the variation present within these groups is forthcoming.

The HYPERICUM PAUCIFLORUM complex

The Mexican-Central American members of *Hypericum* Sect. *Brathys* comprise a most variable group, judging from study of the specimens at the Gray Herbarium, the U. S. National Herbarium, and the Herbarium of the University of Texas. At least seventeen species have been described but several of these appear to represent only ecotypic variation. The great altitudinal diversity (from sea level to at least 12,000 feet) present in Mexico and Central America is most certainly correlated with much of the observable variability.

The taxa which belong to the so-called *H. pauciflorum* complex include the following: *H. brevistylum* Choisy, *H. denticulatum* HBK, *H. eastwoodianum* Johnston, *H. fastigiatum* HBK, *H. gnidioides* Seem., *H. hintonii* Bullock, *H. hondurasense* Keller, *H. longibracteatum* Keller, *H. paniculatum* HBK, *H. pauciflorum* HBK, *H. paucifolium* S. Wats., *H. pinetorum* Standley, *H. pratense* Cham. & Schl., *H. schaffneri* S. Wats., *H. silenoides* Juss., *H. submontanum* Rose, *H. uliginosum* HBK, and *H. woodsonii* Standley. These plants are related to the United States species *H. cumulicola* (Small) P. Adams, *H. denticulatum* Walt., *H. drummondii* (Grev. & Hook.) T. & G., and *H. gentianoides* (L.) BSP. Finally, the very distinctive *H. setosum* L., a plant of the United States Atlantic and Gulf Coastal Plain, is clearly a member of this complex also. Its pilose stems and leaves and ciliate sepals, not present in any other *Hypericum* in North America, are probably an independent evolutionary development.

Research in this complex should include field observations on growth form, perennation, altitudinal effects upon the plant body, and chromosome counts, as well as the usual examination of herbarium specimens. Pending the completion of at least a synoptic treatment of these taxa I would strongly advise against the publication of putative hitherto undescribed taxa. To continue to add to an obviously overburdened synonymy seems to be most unwise.

The HYPERICUM PUNCTATUM complex

Another group within *Hypericum* which is obviously in need of intensive study is the *H. punctatum* complex of Sect. *Hypericum,* as currently circumscribed (Keller, 1925). At least six species are recognized, including *H. formosum* HBK, *H. graveolens* Buckley, *H. mitchellianum* Rydberg, *H. pseudomaculatum* Bush, *H. punctatum* Lam., and *H. scouleri* Hook. These taxa are morphologically very similar and, therefore, presumably closely related. One of these, *H. formosum,* is a plant of high elevations from British Colombia southward through western United States and Mexico into Guatemala. The United States plants of this species are

classified either as a separate taxon, *H. scouleri* Hook., or as a variety. Many specimens of *H. formosum*, especially from Mexico and Guatemala, are practically identical with, if not indistinguishable from, those of *H. pseudomaculatum*, a plant of the Ozarkian region of Arkansas. Specimens of these two species compare readily with those of *H. graveolens*, a plant endemic in the Blue Ridge mountains of western North Carolina at high elevations. The Ozarkian *H. pseudomaculatum* has been considered to be a variety of *H. punctatum*, a plant widespread over much of eastern North America (Fernald, 1950). *Hypericum mitchellianum*, also endemic in the Blue Ridge mountains, is doubtfully distinct from *H. punctatum*. In fact, both possess an unusual ring formation of the chromosomes during meiosis (see below). Both *H. graveolens* and *H. mitchellianum* grow in close association at Mt. Mitchell, North Carolina.

At least two members of the *Hypericum punctatum* complex are highly interesting cytologically. During meiosis the sixteen diploid chromosomes become attached end-to-end, forming a ring. Such unusual behavior is often indicative of structural hybridity (Stebbins, 1950). This phenomenon was first reported by Hoar (1931) in Massachusetts plants. During my studies I have observed ring formation in plants of this species from North Carolina and Tennessee. I have also observed this abnormal cytological condition in several collections of *H. mitchellianum*. In the one collection of *H. pseudomaculatum* which I have been able to study (courtesy of Dr. Paul L. Redfearn) no evidence of meiotic irregularity was noted. This is taken to be further evidence supporting the specific distinctness of these plants from *H. punctatum*. No chromosome studies are available for *H. formosum*.

For the cytologically-inclined systematist the *Hypericum punctatum* complex presents a most intriguing problem. Several questions arise. For instance: Is the ring formation found in plants of *H. punctatum* throughout its geographic range? Is this condition actually absent in *H. pseudomaculatum?* Would intensive study reveal its presence in *H. graveolens* and *H. formosum?* What is the relationship between "true" *H. formosum* and the western United States *H.*

scouleri? Would careful study show that perhaps the Ozarkian *H. pseudomaculatum* is really conspecific with the Mexican *H. formosum?* What is the relationship, if any, between *H. punctatum* (a ring-forming plant) and these three taxa? Is the endemic *H. mitchellianum* worthy of taxonomic recognition and, if so, what is its relationship to *H. punctatum?* Could it be merely a high altitude ecotype of *H. punctatum?* These are merely a few of the more obvious questions which come to mind; doubtless many other problems exist within the *H. punctatum* complex.

The HYPERICUM CANADENSE complex

This highly polymorphic group within Sect. *Brathys* of eastern North America has long been a puzzle to botanists. The species limits are not at all clear. At least five are generally recognized, including *H. boreale* (Britt.) Bickn., *H. canadense* L., *H. gymnanthum* Engelm. and Gray, *H. majus* (Gray) Britt., and *H. mutilum* L. The taxonomic difficulties may well be due to extensive hybridization, as suggested by Fernald (1950). The principal taxonomic characters (at least those currently in use) are in the vegetative body, especially the leaves. Since these plants frequently grow on soils of varying wetness it is not at all unlikely that the habitat may affect the commonly-used characteristics. I have observed one species, *H. mutilum*, at many stations in northern Florida and southern Georgia and have noticed great variation in size and habit of the plants and in the size of the leaves. The presence of vegetative reproduction is an additional complicating factor, rendering the collection of poulation samples most difficult.

Numerous problems are suggested by even a cursory examination of the herbarium material and the literature. For example: Does hybridization actually occur? If so, is *H. dissimulatum* Bickn., as suggested by Fernald (1950), really "an unusually constant and recurrent hybrid" of *H. boreale* or *H. mutilum* and *H. canadense?* What is the status of Fernald's three varieties of *H. mutilum?* I can detect little, if any, geographic localization of any of them, excepting perhaps var. *latisepalum* which seems to be restricted

to the Atlantic and Gulf Coastal Plain. What is the status of Fernald's varieties *magninsulare* and *galiiforme* of *H. canadense?* Both appear to me to be merely responses to unusual habitat situations and perhaps not worthy of taxonomic recognition.

The HYPERICUM DENTICULATUM complex

An interesting problem involving variation within *Hypericum denticulatum* Walt. is discernible. According to Fernald and Schubert (1948) this species of the eastern United States comprises three varieties, each with some degree of geographic localization. One of these, var. *denticulatum,* grows on the Atlantic Coastal Plain from New Jersey southward to at least South Carolina. Fernald and Schubert's map also shows a station on the Cumberland Plateau in central Tennessee, a disjunction of at least three hundred miles from the nearest South Carolina locality. A second variety, *recognitum,* is principally a plant of the upland and mountainous areas from southeastern Virginia, through the inner Piedmont of North Carolina to northeastern Alabama and northward into southern Indiana and West Virginia. Fernald and Schubert's map shows an occasional station near the Fall Line in South Carolina, Georgia, and Alabama. The third variety, *acutifolium,* is scattered about the southeastern United States, with occasional stations on the outer Piedmont of Virginia and North Carolina, the Coastal Plain of South Carolina and adjacent southeastern North Carolina, northern Florida, the outer Piedmont of Georgia and adjacent Alabama, and the Cumberland Plateau of Tennessee.

Leaf shape was the principal feature used by Fernald and Schubert (1948) to distinguish these three varieties. In one, var. *acutifolium,* all or at least the middle and upper leaves were described as "narrowly linear or linear-lanceolate" while in a second, var. *denticulatum,* the leaves were "narrowly to broadly ovate, oval or oboval." These two extremes in leaf shape can be recognized fairly easily. The var. *recognitum* is very obscure, however, the leaves appearing to be intermediate between the two extremes. Fernald and Schubert acknowledged that "the three varieties may merge" and

that "nondescript individuals can be found." In fact, two of these taxa, var. *acutifolium* and var. *recognitum*, may even grow closely associated within the same habitat, judging from Fernald's annotations on herbarium material. Obviously, therefore, *H. denticulatum* is in need of careful and intensive study, especially in the field. It is not unlikely that some differentiation may have occurred, rendering the plants of the Coastal Plain slightly distinct from those of the Piedmont and the mountains. However, I think that the variation picture within this species is not so easily understood as Fernald and Schubert's analysis would suggest.

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THE USE OF VAPOR FRACTOMETRY IN THE ANALYSIS OF SOME NEW ENGLAND HOPS[1]

EDWARD L. DAVIS AND RICHARD L. BURNS

In recent years a number of articles have been published on the use of chemical characteristics in taxonomic studies (e.g. Turner and Alston, 1959; Alston and Irwin, 1961). These examples have shown that chemical analysis can be extremely useful in areas where extensive morphological or taxonomic information has been accumulated. Not only may the chemical analysis "solve" certain taxonomic problems, but it may also serve to substantiate conclusions formed originally on morphological features alone and in this way give greater credence to studies which have been based heavily upon qualitative rather than quantitative observations.

We are reporting here the use of a very sensitive method of chemical analysis, vapor fractometry, as it is applied to the problem of subspecific variations in the hops plant, and its correlation with morphological studies which have been done previously. The genus *Humulus* is a small one consisting of two distinct species, one a perennial and the other an annual. Several attempts have been made to distinguish two or more separate species of the perennial hops. The difficulty of this separation, from herbarium material, has been considered in detail (Davis, 1957). Within the perennial species, *Humulus lupulus* L., it is clear that there are variants, but these are not distinct enough to justify specific rank. After a study of cultivated hops from throughout the world, and wild hops of North America, the perennial hops were divided into "complexes" which represent approximately varietal differences. The differences between these complexes were based upon cytological and morphological features. Such features as the angularity and scar occurring on the cone axis; pubescence, dentation and lobing of the leaf; venation of the cone bract; and pairing of the sex chromosomes have been used. It is still premature to

[1]This research was supported by a grant from the National Science Foundation, NSF-G18013.

attempt to delimit these complexes in a definite way. Additional studies since 1957 have shown the complexity of the situation. Neve's work on hops chromosomes (1956, and personal communications) make it necessary to withhold final judgement as to chromosome types which might fit American, Continental and English complexes of hops. Work is being done at present upon the cytological features of the hops in the American Rockies and this should lead to more positive conclusions.

A comparison of morphological features and alpha acid content among cultivated varieties suggests that there is a difference in the proportion of humulone and cohumulone between the different morphological groups. Rigby (1956) and Howard and Tatchell (1955) classified hops according to the cohumulone content of the humulone complex and made 4 groups with approximately 20%, 30%, 40% and over 40% cohumulone. Examination of morphological features of many of these varieties show those with 20-25% cohumulone to correspond very closely to the Continental complex; those with 26-35% cohumulone to the English complex, and those with cohumulone of 36% and above to the American type. Considerable caution must be used in drawing these comparisons. It is necessary to establish that these chemical differences are not due to environmental conditions. Fortunately, extensive evidence indicates that although the absolute amounts of these substances are changed by the environment, the relative proportions are not. Commercial samples of the same variety, grown in very different habitats and in different seasons have fallen into the same chemical groups (Howard and Tatchell, 1956). Additional plant by plant studies over a number of years, already in progress, will be desirable to confirm this, but present evidence favors the stability of the chemical characteristics. A more fundamental problem is related to drawing conclusions about a correlation of structural features and chemical tests based upon the kind of samples which have been examined so far. Neve and Weston (1958) have very clearly stated this problem in relation to the resins and oils in hops. The cultivated varieties of hops are not a random sample. It is

not surprising that as a result of selection there are certain common characteristics within each of the three major groups of cultivated varieties, both in chemical and morphological features. These cultivated plants represent a very small fraction of the variation within the species. Also, within each group some common genetic background must occur, although their ancestry is very incompletely known. Working in the experimental fields at the Hops Research Station at Corvallis, Oregon, with the morphological complexes referred to earlier, the senior author found that among the many hundred of crosses there were many plants which would not fit easily into any of the three complexes suggested. The difficulties were much greater than had been observed among collections of wild hops throughout North America. Although this topic will be developed more fully in a later paper, it is clear that under natural conditions many of the potential hops types do not survive, and that there are strong forces limiting the variants within wild plants. For example, it was shown previously (Davis, 1957) that the wild hops of the midwestern United States are remarkably uniform, but that hops in the Rocky Mountains and New England are extremely variable. Only the American type has so far been found in the midwest, but apparent variants of Continental and English hops occur in the Western and Eastern parts of North America. Valuable as the morphological analysis has shown itself to be, we have had a considerable desire to find some other method of approach to determine if the heterogeneity in wild hops is real and related to that occurring among cultivated plants and not due to a weakness in the morphological classification itself. Cytological studies are being conducted, but because of the very limited information on chromosome types in wild American hops it is impossible to interpret the results at this time. Another alternative is offered by the humulone complex of substances which have been shown to be different in American and European cultivated hops. We have indicated that this method of analysis, which is firmly established in respect to the chemical procedure, still requires study before its biological and genetical value can

be established beyond any possible doubt, but that there is much information which justifies its use at present.

The wild hops of New England are particularly fascinating because in addition to their botanical variation they present an intriguing problem due to historical circumstances. It is not certain that hops are native to New England. Cultivation in the New England Colonies occurred so early (probably with English hops) that there is a question as to whether wild hops are exclusively escapes from cultivation or a mixture of wild and escaped plants. Asa Gray (1886) refers to wild hops scattered on banks of streams from Canada west to New Mexico, but he is not clear about New England where he notes that all cultivated plants are undoubtedly of European origin. Nuttall (1847) is certain that hops are native to the Rocky Mountains, but did not commit himself on New England. During Revolutionary days, New England and particularly the Connecticut River Valley, was the center of hops cultivation in the United States. There can be no doubt that English hops were grown here and had ample opportunity fifty to two hundred years ago to become established. Our previous analysis of New England hops, from herbarium material, has shown the leaf pubescence pattern typical of English hops to be by far the most common, but in at least some characteristics all three complexes are represented. As we gradually learn more about the hops now wild in New England we will know whether they are related to English hops only, or to Continental and American hops as well. Chemical analysis should contribute significantly to this picture.

EXPERIMENTAL PROCEDURE

The determination of the relative proportions of humulone, cohumulone and adhumulone in the alpha acids was first done by the technique of Verzele and Govaert (1955) by separating the humulone complex on a silica gel column, followed by the determination of the relative amount of each compound with a Beckman Du spectrophotometer, measuring absorbancy at 276 mμ. This procedure did permit a separation of the individual components, but it proved

very difficult to replicate the results quantitatively. A much more exact method, developed by Rigby, Sihto, and Bars (1960) involves extracting from the hops cones the alpha acids, precipitating them as a lead salt, pyrolyzing the salt to break off isobutyric, 2-methylbutyric, and isovaleric acid from the molecules of cohumulone, adhumulone and humulone respectively. Rigby has shown that this technique gives results very similar to that from a separation of the humulone complex by the much more time consuming countercurrent distribution technique. The fatty acids were then esterified with isopropyl alcohol, and the isopropyl esters separated on a chromatographic column (type R, Perkin-Elmer) at 100°C, and a helium gas flow rate of 120 ml/min, using a Perkin Elmer vapor fractometer, Model 154. The details of the extraction and preparation of the fatty acid esters are to be found in Methods of Analysis of Assoc. of Agric. Chemists (1945) and Rigby, Sihto, and Bars, (1960). The relative quantity of each component was determined by calculation of the areas under the curves for each acid, as recorded by the fractometer recorder, and the results reported as a percentage of the total alpha acid.

RESULTS

Several hops plants were collected from Massachusetts and Maine and their morphological and chemical characteristics determined. Other plants from Vermont, Maine and Massachusetts produced such a poor yield of cones that it was impossible to analyze the alpha acids and the morphological analysis of these plants has not been included in this study. For comparative purposes commercial samples of Idaho Seedless hops (a Late Clusters type) and cones from a plant of Late Clusters grown in Amherst are included. Late Clusters belongs to the American complex of hops. Table I contains the results of the chemical analysis. Three tests were run on each hop. Table 2 shows the results of the examination of morphological features. In each table, the sample is assigned to a "type" in the last column. The details of the morphological analysis is found elsewhere (Davis, 1957).

DISCUSSION

Comparison of the tables for morphological and chemical analysis shows that when the cohumulone scale is established as indicated, there is an exact correspondence between morphological and chemical types. The scale was established prior to this study, after comparing the work on cultivated varieties referred to above. It does not imply, for example, that all plants cultivated or wild, bearing the designation American, are of origin within North America. Such a conclusion could only be drawn at the completion of an extensive study. Rather, the terms American, Continental, and English were chosen because, of the wild and cultivated plants studied, these designations were the most descriptive of their center of distribution. It may be necessary to add additional designations for other parts of the world, or to establish several complexes for the large areas like North America. The more important goal is to establish a chemical analysis that will support morphological investigations. These preliminary results are very encouraging in this respect.

The hops from Biddeford, Maine were found growing in sand near the coast and could not have been in cultivation at any time. Those from Windsor, Massachusetts lined a fence near fields long deserted. They certainly had not been cultivated where they were growing, but might have escaped from cultivation in this area in recent times. The collection from Dalton, on the other hand, was of plants which had been used for brewing within the last 25 years.

Chemical analysis shows the Dalton hops to be strikingly similar to the cultivated Late Clusters, such as is grown in Idaho. The sources of its roots are unknown, but it is not unreasonable to suggest that they were obtained commercially from a supplier of cultivated hops, and not brought into cultivation from the wild state. The hops from Maine and Windsor, which may have been seedlings from cultivated plants of several generations ago are similar to English cultivated types. In morphological features they resemble the oldest herbarium material of New England hops.

With a continued examination of hops about which

detailed information on their history is available, we should be able to answer the question as to whether or not American type hops in New England are only of recent origin with as much certainty as is possible in this kind of taxonomic problem. Perhaps most important, these preliminary chemical tests confirm our previous observations of a morphological variation in New England wild hops which corresponds to the variation between cultivated hops throughout the world, and gives additional support to the use of morphological evaluation in tracing the evolution of hops.

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TABLE I

CHEMICAL ANALYSIS

	Percentage of cohumulone	adhumulone	humulone	TYPE*
Idaho Seedless (1961 crop)	49.2	8.7	42.1	
	48.6	8.4	43.0	
	46.8	10.4	42.8	
average	48.2	9.2	42.6	American
Late Clusters (Amherst)	36.1	14.9	49.0	
	37.8	15.7	46.5	
	37.6	13.2	49.2	
average	37.2	14.6	48.2	American
Dalton, Mass.	46.0	10.5	43.5	
	47.9	8.6	43.5	
	45.6	12.2	42.2	
average	46.5	10.4	43.1	American
Windsor, Mass.	32.2	13.0	54.8	
	32.5	12.8	54.7	
	35.7	13.2	51.1	
average	33.5	13.0	53.5	English
Biddeford, Maine	29.6	13.1	57.3	
	24.9	12.9	62.2	
	24.8	12.8	62.4	
average	26.4	12.9	60.6	English

* The designation is based upon a scale for cohumulone of: Continental, 20-25%; English, 26-35%; American, 36% and over.

TABLE 2
MORPHOLOGICAL ANALYSIS

Origin of Hops	Cone		Leaf			Classification Type
	Bract scar on axis	Angularity of axis	Veins on Bract	Dentations on central lobe	Pubescence on lower surface	
Idaho Seedless (1961 crop)	Short	130°	11	36	On all veins & between veins	American
Late Clusters (Amherst)	Short	118°	11	44	On all veins & between veins	American
Dalton, Mass.	Short	110°	12	44	On all veins & between veins	American
Windsor, Mass.	Short	134°	7	24	On main veins only	English
Biddeford, Maine	Short	136°	7	24	On main veins only	English
"Typical"* American hops	Short	110°-130°	10-up	34 up	On all veins & between veins	American
"Typical"* English hops	Short	130°-150°	7-9	20-26	On main veins only	English

* Detailed descriptions of the American and English hops are to be found in the paper of Davis (1957).

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CHROMOSOME NUMBERS IN THE COMPOSITAE. VI. ADDITIONAL MEXICAN AND GUATEMALAN SPECIES.

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The present contribution is essentially a continuation of several papers, the latest of which (Turner *et al.*, 1961a)

dealt with chromosome counts from species of southern Mexico and Guatemala.

Chromosome counts were made from pollen-mother-cell squashes as outlined by Turner and Johnston (1961). Voucher specimens (table 1) are deposited at the University of Texas Herbarium; these were collected during the year 1961. The tribal and subtribal arrangements listed in table 1 follow those of Hoffmann (1894).

While most of the identifications are our own we would like to acknowledge the kind assistance of Dr. Kittie Parker and Dr. Arthur Cronquist for the identification of certain difficult taxa.

EUPATORIEAE — *Eupatorium* ($x = 10, 17$). Chromosome counts for the 7 species listed in table 1 are consistent with the basic numbers obtained for the approximately 40 other species examined (Turner *et al.*, 1961b). *E. pycnocephalum* ($n = 10, 20$), a widespread, highly variable species, apparently consists of diploid and tetraploid races, some of these being in close proximity to each other (cf. *King 4242* and *4243A*, table 1).

Piqueria ($x = 12, 11$). The 2 species listed in table 1 are diploid with $n = 12$; Turner and Johnston (1961) have reported one other species, *P. laxiflora*, to be diploid with $n = 11$.

Mikania cf. *gonzalezii* ($n = 17$) is the second species of the genus to be counted. Other workers have reported the widespread species, *M. scandens*, to be diploid with $2n = 38$ (Darlington and Wylie, 1956) or $2n = 36$ (Mangenot and Mangenot, 1958).

Chromosome counts for the species of *Ageratum* ($n = 10, 20$), *Brickellia* ($n = 9$) and *Oxylobus* ($n = 16$) are consistent with the basic numbers obtained for these genera by other workers (Turner *et al.*, 1961a; Gaiser, 1953; Beaman *et al.*, 1962). The chromosome count for *Trichocoronis wrightii* ($n = 15$) is a first report for the genus.

ASTEREAE — *Aster bimater* ($n = 5$) is related to *A. lima* Lindl.; it apparently belongs to the Section Aster (subsection Homophylli) as treated by Gray (1886). Chromosome

[1]This study was supported by National Science Foundation Grant 9025.

numbers on a base of $x = 5$ occur in the sections Oxytripolum (annuals and biennials) and Aster (perennials) of the genus *Aster*. In the former section only counts of $n = 5$ or 10 are known while the latter has species with both $n = 5$ and $n = 9$. *A. exilis* var. *australis* ($n = 5$) belongs to the section Oxytripolum; several additional counts of the species (all $n = 5$) were reported by Turner *et al.* (1961b; cited as *A. subulatus* Michx.).

Erigeron ($x = 9$) — The chromosome numbers of the several species listed in table 1 are consistent with the basic number obtained for numerous other taxa (Montgomery and Yang, 1960). *E. scaposus* with $n = 9$II, 18II, and 27 (9II and 9I) is a widespread, variable species, apparently consisting of diploid, tetraploid and triploid races.

Psilactis ($x = 4$, 9, 8?). Chromosome counts for the 2 species listed in table 1 are particularly interesting in that they parallel the multibasic condition found in *Aster* (Turner *et al.*, 1961b). Meiotic figures of *P. brevilingulata* with $n = 9$ appeared to be unequivocal for at least one collection *(King 2939)* but for the other collections listed the counts might have been 8II and 2 fragments as indicated for the Powell and Edmondson collection (the 2 "fragments" taking less stain than the well defined bivalents, but occurring together at meiosis as if they were pairing). As in *Chrysopsis* ($x = 5$, 4 and 9) and in *Aster* ($x = 5$ and 8, 9) the species of *Psilactis* with the lower basic number has relatively large chromosomes. *Psilactis* is composed of only 4 or 5 species, these restricted to the southwestern United States and Mexico. It is a closely knit group of doubtful affinity; Gray in his original description of the genus placed it "between Dieteria [= *Machaeranthera*] and Aster, except from the want of pappus in the ray. . . ." Superficially, at least in habit, the species centering about *P. brevilingulata* and *P. asteroides* appear closest to the genus *Aster*, section Aster or Oxytripolium, both of which, as indicated above, have species with $n = 5$. However, an inclusive morphological study of *Psilactis* (Turner & Horne, unpublished) shows the relationship of *Psilactis* to be closer to *Machaeranthera*, particularly through *P. coulteri* which is a

good match for *Machaeranthera parviflora* Gray, as indicated by Gray in his original description of this latter species.

Chromosome numbers for the species of *Haplopappus, Heterotheca, Machaeranthera, Solidago* and *Xanthocephalum* (table 1) are consistent with the basic numbers previously reported for these genera (Turner, 1961b; Darlington and Wylie, 1956; Solbrig, 1961).

INULEAE — Chromosome counts for the species of *Gnaphalium* ($n = 7, 14$) and *Pluchea* ($n = 10$) are consistent with the basic numbers reported for these genera by previous workers.

HELIANTHEAE — Melampodinae — *Polymnia* ($n=16, 17$). Mr. J. E. Wells of Ohio State University is currently studying the genus and has found yet other species with $n = 15$ (personal communication). Chromosome counts for *Berlandiera* ($n = 15$), *Parthenium* ($n = 18$) and *Dugesia* ($n = 18$) are consistent with counts reported for these genera by previous workers (Turner and Johnston, 1956; Turner *et al.*, 1961a).

ZINNINAE — *Heliopsis buphthalmoides* ($n = 28$). A collection of this species from Oaxaca, Mexico was reported to be diploid with $n = 14$ by Turner *et al.* (1961b). Fisher (1957) reported counts for 6 other taxa of the genus; all were diploid with $n = 14$. *Philactis* is a genus with perhaps 2 or 3 species. *P. nelsonii* ($n = 28$) is probably a tetraploid on a base of $x = 14$ since the genus is closely related to *Heliopsis*.

Zinnia maritima ($n = 13$). Previous published counts for species of *Zinnia* have been $n = 10$, 11, 12, 19, and 21 (Torres, 1961). The meiotic figures for *Z. maritima* were particularly clear (Fig. 11). A collection of *Z. angustifolia* from San Luis Potosi was reported as diploid with $n = 11$ by Turner *et al.* (1961b); the Nayarit collection of this species (table 1) was found to be diploid with $n = 12$, agreeing with counts obtained for the species by Torres (personal communication). *Zinnia* is obviously a multibasic taxon with $x = 10$, 11, 12, 13, 19 and 21. (The latter two counts are probably derived through amphiploidy or else through

aneuploid loss and gain respectively from a tetraploid on a base of $x = 10$.)

Sanvitalia ($x = 8$). A number of chromosome counts have been reported for this genus; all have been diploid or tetraploid on a base of $x = 8$ (Turner *et al.*, 1961a; 1961b).

The subtribe Zinninae, as treated by Hoffmann (1894), includes only 6 genera: *Philactis* (including *Grypocarpha;* Blake, 1930), *Heliopsis, Aganippea, Tragoceros, Sanvitalia* and *Zinnia.* Five of the 6 genera have been counted and basic chromosome numbers of $x = 8$, 10, 11, 12, 13 and 14 have been established (excluding the chromosome counts of a presumed polyploid origin). At least two obvious hypotheses may be tentatively proposed to account for this sequence of numbers: (1) That the genera have been derived through progressive aneuploid gain from an ancestral base of $x = 8$ or else the reverse has occurred from an ancestral base of $x = 14$. In either case one would have to assume that, contrary to the situation in many other composite genera, the hypothetical taxa on a base of $x = 9$ were lost from the sequence. Another hypothesis may be proposed which avoids this difficulty, this being that $x = 4$ is the ancestral basic number of the subtribe, the numbers $n = 8$, $n = 12$ being tetraploid and hexaploid respectively, chromosome numbers of $n = 11$, 10 and 13, 14 being derived through both aneuploid gain and loss.[3]

VERBESININAE — *Aldama dentata* Less. (Not *Aldama dentata* Llave & Lex.) This species has been treated as belonging to the genus *Sclerocarpus* by several workers where it is called *S. schiedianus* because of the earlier name, (*S. dentata* (Llave & Lex.) B. & H. ex Hemsl.). Morphologically *Aldama dentata* Less. is quite different from *Sclerocarpus* proper, lacking the conspicuous clawed rays of the latter genus and possessing in addition rather distinct achenes and involucral bracts. As indicated in table 1,

[3]Any number of alternate numerical hypotheses could be proposed, one of the most provocative being that suggested by Satô (1960). He postulates that the ancestral chromosome number ("protokaryotype") for the plant kingdom might be $x = 2$, presumably the major phyletic lines becoming established on this base. Obviously with such a low basic number one could assume, on numerical grounds at least, that *all* higher numbers are polyploids from such a base, the odd numbers simply being aneuploid derivatives.

Aldama dentata Less. has a chromosome number of $n = 17$, while true *Sclerocarpus* has chromosome numbers of $n = 11$, 12 and 14 (table 1). *Aldama dentata* Less. appears to be closest to species of the genus *Rhysolepis* (the generic name *Aldama*, being based on *Aldama dentata* Llave & Lex., is synonymous with *Sclerocarpus*). It differs from *Rhysolepis* in being a smaller plant with less pronounced and fewer involucral bracts and smaller flowers, but they are very much alike in floral morphology. While the species of *Rhysolepis* (only 2 have been described) have not been examined for chromosome numbers, what appears to be an undescribed species *(King 3645)* has a number of $n = 17$.

In any case, some disposition of *Aldama dentata* Less. (= *Sclerocarpus schiedianus*) should be made other than its inclusion in *Sclerocarpus;* in our opinion, this is suggested by both the morphological and chromosomal evidence.

Sclerocarpus ($x = 11$, 12, 14). This genus is in much need of critical revision (Mr. Feddema of the University of Michigan is currently undertaking such a study). The species are quite variable, both morphologically and chromosomally. Turner (1960a) previously reported the chromosome number of *S. uniserialis* ($n = 12$); this species is apparently closely related to *S. dentatus* which, as indicated in table 2, has populations and/or individuals with chromosome numbers of both $n = 11$ and 12.

Spilanthes ($x = 13$). Chromosome counts of the several collections listed in table 1 indicate that *S. americana* ($n = 13$, 26, 39) consists of diploid, tetraploid and hexaploid races and/or taxa. One other species, *S. decumbens*, has been reported as diploid with $n = 13$ (Darlington and Wylie, 1956).

Viguiera ($x = 8$, 17, 18). Heiser and Smith (1955) and Heiser (1960) reported counts of $n = 18$, 17 and 8 for species of this genus. Turner (1960) and Turner *et al.* (1961) reported several counts of *V. dentata* as $n = 17$. *V. longifolia* ($n = 8$), table 1, is closely related to *V. multiflora* which Heiser and Smith reported as $n = 8$. In our opinion the lower number is probably a relictual feature, perhaps being the same as or close to the ancestral diploid number

of the phylad which gave rise to *Viguiera* and related genera. It will be interesting to see if this chromosomal hiatus holds as additional species are examined. Blake (1918) recognized 143 species for the genus but to date only 7 species have been counted.

Wedelia ($x = 11, 12$). The only previous chromosome report for this genus has been that of Turner and Irwin (1960) for the South American *W. brasiliensis* (Spreng.) Blake ($n = 29 \pm 1$). The genus, as presently circumscribed, is multibasic and apparently includes polyploids.

Zexmenia ($x = 10, 11, 14$). Heiser and Smith (1955) have reported one other species, *Z. frutescens* (Mill.) Blake, to be diploid with $n = 11$. With only 5 of the approximately 30 species reported to date (table 1), it appears likely that additional basic numbers will be added to this multibasic series.

Chromosome counts for *Helianthus* ($x = 17$), *Perymenium* ($x = 15$), *Tithonia* ($x = 17$) and *Verbesina* ($x = 16, 17, 18$) are consistent with the basic numbers reported for these genera by other workers (Darlington and Wylie, 1956; Turner *et al.*, 1961a; 1961b).

The chromosome counts for species of *Hymenostephium* ($n = 17$), *Iostephane* ($n = 17$), *Notoptera* ($n = 15$), *Podochaenium* ($n = 17$), and *Salmea* ($n = 18$) are first reports for these genera. Beaman and Turner (unpublished) have obtained chromosome numbers of $n = 9$ for other species of *Jaegeria*, thus the two species with $n = 18$ (table 1) are tetraploids.

COREOPSIDINAE — *Coreopsis mutica* ($n =$ ca. 24, 26). This species is a shrub up to 3 meters high; while the counts are only approximate they do indicate the species to be tetraploid since most taxa in the genus are on a base of $x = 12, 13, 14$ (Turner, 1960b). Chromosome counts for the species of *Dahlia* ($n = 18$) and *Cosmos* ($n = 12$) are consistent with the basic numbers established by other workers (Darlington and Wylie, 1956).

GALINSOGINAE — *Calea integrifolia* ($n =$ ca. 16) — Turner *et al.* (1961b) reported a chromosome count of $n =$ ca. 17 for this species. No certain count could be made from the

present collection, but the meiotic figures appeared to be $n = 15$ or 16, the latter count being obtained more frequently. The chromosome count for *C. trichotoma* ($n = 18$) is the first unequivocal count for the genus.

Sabazia sp. nov. ($n = 18$) — Turner and Johnston (1961) have reported the only other species count, *S. humilis* ($n = 4$).

Galinsoga parviflora ($n = 8$, 16). This species has heretofore been reported as diploid with $n = 8$ (Haskell and Marks, 1952); the 6 collections from southern Mexico and Guatemala listed in table 1 were tetraploid, while the 2 collections from Central Mexico were diploid. Haskell and Marks recognized 2 species in the *G. parviflora* complex in the British Isles (both introduced): *G. ciliata* (Raf.) Blake ($n = 16$) and *G. parviflora* ($n = 8$). Fernald (1950) recognized 4 species as belonging to the complex in the northeastern United States maintaining both *G. parviflora* and *G. ciliata*. Most authors have distinguished between the latter 2 taxa by a combination of technical features such as stem pubescence, absence or presence of a pappus on the ray florets, etc. (Fernald, 1950; Clapham *et al.;* etc.). The several characters used to distinguish these 2 taxa are, in our opinion, slight and while they might hold for the introduced populations in Britain, they do not hold singly or in combination for the Mexican material (nor apparently for the material from temperate North and South America, although there is a tendency for more glabrate forms in temperate latitudes; specific recognition of such races hardly seems warranted in view of the widespread, weedy nature of the taxon).

HELENIEAE — *Schkuhria anthemoides* ($n = 20$). Chromosome counts for 2 South American species, *S. pinnata* ($n = 10$) and *S. multiflora* ($n = 11$), have been reported by other workers (Darlington and Wylie, 1956). As indicated in table 1, the North American populations of *S. pinnata* are apparently tetraploid.

Perityle microglossa ($n =$ ca. 46 ± 4). The chromosome number of a Texas collection of this species was reported as $n = 36$ by Turner and Ellison (1960).

Galeana pratensis ($n = 9$). This is the first chromosome count reported for the genus.

SENECIONEAE — *S. imparipinnatus* ($n = 23$). Chromosome counts for most species of the genus *Senecio* have been on a base of $x = 5$; however at least 2 other species are known with counts of $n = 23$ (Turner *et al.*, 1961b).

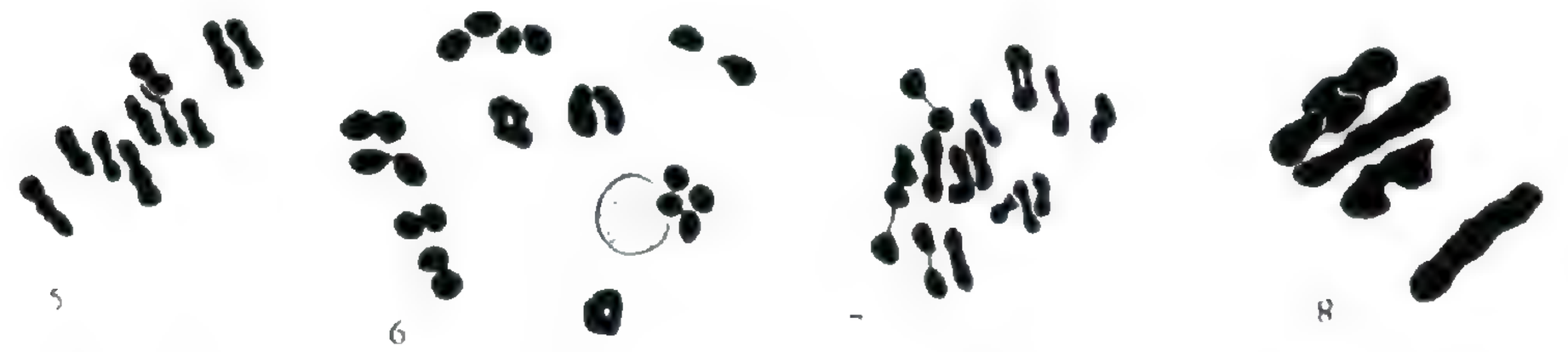
Neurolaena lobata ($n = 11$). Counts for this genus have not been reported previously.

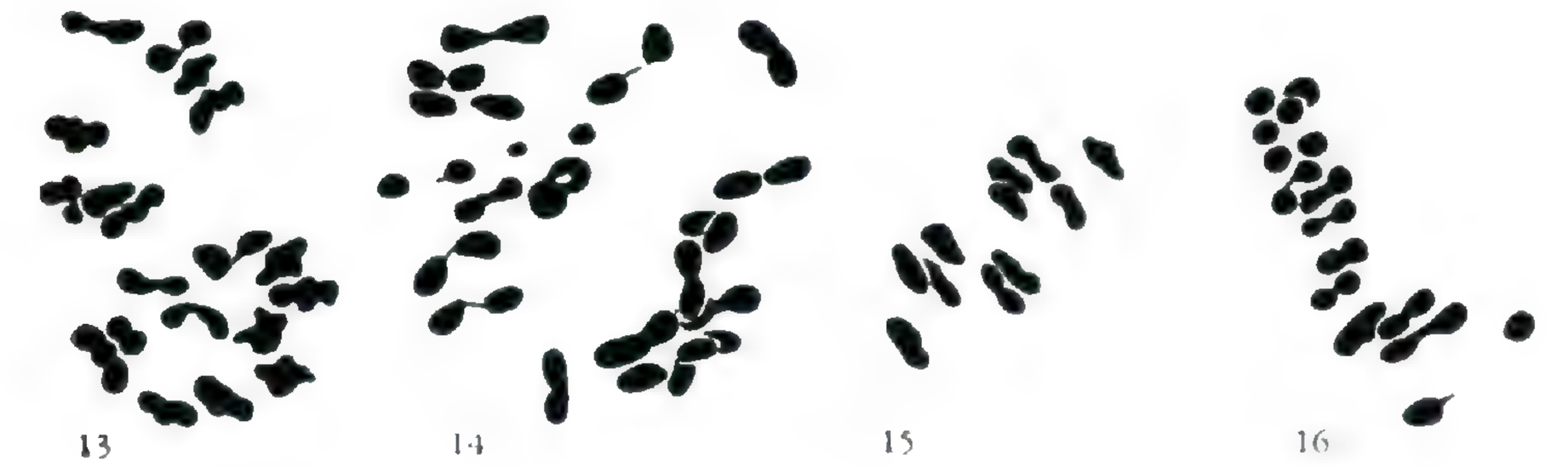
MUTISIEAE — *Trixis radialis* ($n = 27$). Only 11 of the approximately 66 genera in the tribe Mutisieae have been counted. Including *Trixis*, 4 of the 11 are unibasic with $x = 27$; the unusually high basic number is apparently polyploid in origin, presumably from an ancestral base of $x = 9$ (the haploid number, $n = 9$, is not known in those members of the tribe studied to date, but the Australian genus *Trichocline* has been reported as $n = 18$).

SUMMARY

Chromosome counts for species of *Piqueria* ($n = 12$), Mexican and Guatemalan Compositae representing 133 taxa (131 species and 2 varieties) distributed in 66 genera. Counts of approximately *100* of the species are reported for the first time including the following genera: *Calea*, $x = 18$; *Galeana*, $x = 9$; *Hymenostephium*, $x = 17$; *Iostephane*, $x = 17$; *Jaegeria*, $x = 9$; *Neurolaena*, $x = 11$; *Notoptera*, $x = 15$; *Philactis*, $x = 28$; *Podochaenium*, $x = 19$; *Psilactis*, $x = 4, 9, (8?)$; *Rhysolepis*, $x = 17$; *Salmea*, $x = 18$; *Tragoceros*, $x = 11$; *Trichocoronis*, $x = 15$; *Trixis*, $x = 27$; and *Wedelia*, $x = 11, 12$.

Chromosome counts for species of *Piqueria* ($n = 12$), *Mikania* ($n = 17$), *Polymnia* ($n = 17$), *Zinnia* ($n = 13$), *Sclerocarpus* ($n = 11, 14$), *Wedelia* ($n = 11, 12$) and *Zexmenia* ($n = 10, 14$) differ from the reported basic numbers as determined from other species in these genera. When appropriate the chromosomal information has been related to systematic problems. BOTANY DEPARTMENT AND THE PLANT RESEARCH INSTITUTE, UNIVERSITY OF TEXAS, AUSTIN.





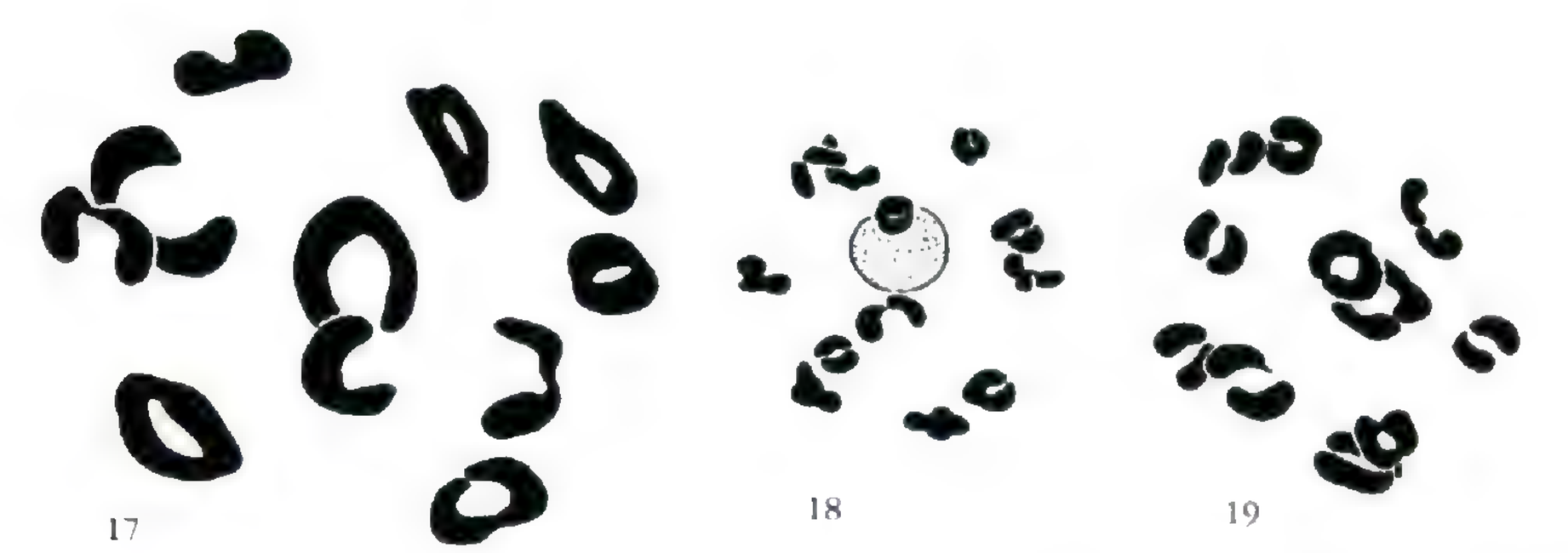
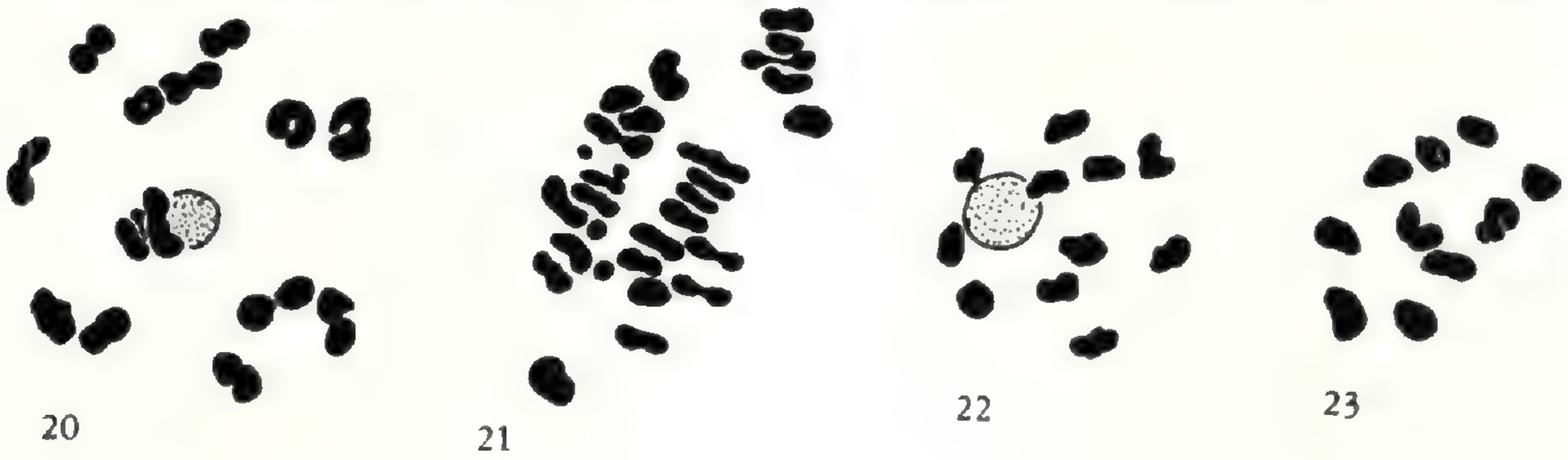
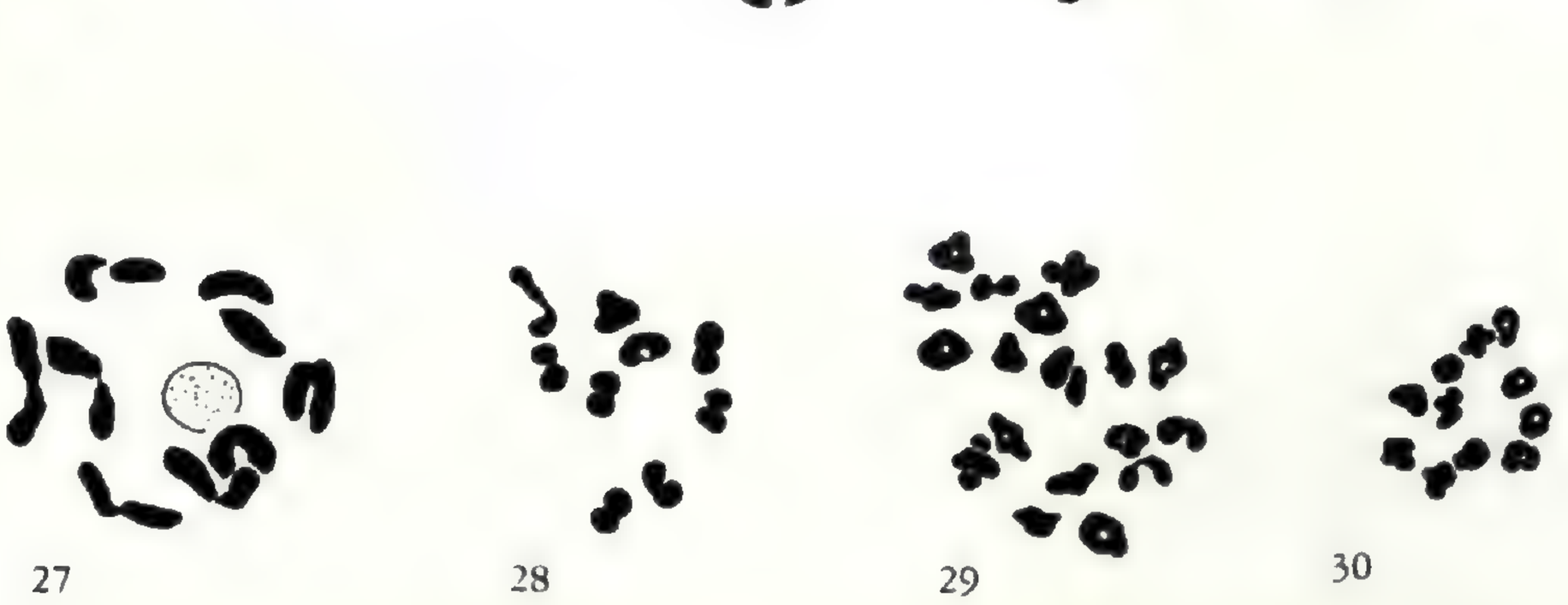


Fig. 1-33. Meiotic chromosomes of species of Compositae. — Fig. 1. *Ageratum corymbosum* ($n = 10 + 6$ fragments) — Fig. 2. *Eupatorium morifolium* ($n = 10$) — Fig. 3. *Eupatorium petiolare* ($n = 17$) — Fig. 4. *Eupatorium pycnocephalum* ($n = 20$) — Fig. 5. *Eupatorium pycnocephalum* ($n = 10$) — Fig. 6. *Piqueria pilosa* ($n = 12$) — Fig. 7. *Trichocoronis wrightii* ($n = 15$) — Fig. 8. *Machaeranthera gymnocephala* ($n = 4$) — Fig. 9. *Psilactis* cf. *asteroides* ($n = 4$) — Fig. 10. *Polymnia* cf. *apus* ($n = 16$) — Fig. 11. *Zinnia maritima* ($n = 13$) — Fig. 12. *Iostephane heterophylla* ($n = 17$) — Fig. 13. *Podochaenium eminens* ($n = 19$) — Fig. 14. *Salmea scandens* ($n = 18 + 2$



20 21 22 23

24 25 26



27 28 29 30

31 32 33

fragments) — Fig. 15. *Sclerocarpus dentatus* (*n* = 11) — Fig. 16. *Sclerocarpus dentatus* (*n* = 12) — Fig. 17. *Sclerocarpus* cf. *divaricatus* (*n* = 11) — Fig. 18. *Sclerocarpus* cf. *frutescens* (*n* =12) — Fig. 19. *Sclerocarpus* cf. *phyllocephalus* (*n* = 11) — Fig. 20. *Sclerocarpus sessilifolius* (*n* = 14) — Fig. 21. *Spilanthes americana* (*n* = 26 + 4 fragments) — Fig. 22. *Wedelia filipes* (*n* = 11) — Fig. 23. *Zexmenia* cf. *aurea* (*n* = 10) — Fig. 24. *Zexmenia costaricensis* (*n* = 11) — Fig. 25. *Zexmenia pringlei* (*n* = 14) — Fig. 26. *Zexmenia virgulata* (*n* = 11) — Fig. 27. *Sabazia* sp. nov (*n* = 8) — Fig. 28. *Galeana pratensis* (*n* = 9) — Fig. 29. *Schkuhria anthemoides* (*n* = 20) — Fig. 30. *Neurolaena lobata* (*n* = 11) — Fig. 31. *Senecio imparipinnatus* (*n* = ca. 23) — Fig. 32. *Arctotis stoechadifolia* (*n* = 9) — Fig. 33. *Trixis radialis* (*n* = 27). x ca. 2000.

TABLE 1. SPECIES OF COMPOSITAE EXAMINED FOR CHROMOSOME NUMBER

VERNONIEAE

Vernonia karwinskiana Hort.
$n = 17 \pm 1$ HIDALGO: 9 m. ne. of Jacala. *King 4216.*

EUPATORIEAE

Ageratum corymbosum Zucc.
$n = 10$ CHIAPAS: 23 m. se of Comitán. *King 3045.*
$n = 10^a$ (Fig. 1) PUEBLA: 4 m. w. of Izúcar de Matamoros. *King 2923.*
$n = 10^a$ OAXACA: 14 m. ne. of Huajuapan de Leon. *King 3544.*

Ageratum houstonianum Mill.
$n = 10$ GUATEMALA: 4 miles south of Coban. *King 3311.*
$n = 10$ MORELOS: 11 miles south of Cuernavaca. *King 4160.*

Ageratum latifolium Cav.
$n = 10$ HIDALGO: 12 m. sw. of the Hidalgo-San Luis Potosi state border along route 85. *King 4226.*
$n = 10$ PUEBLA: 6 m. sw. of the Puebla-Veracruz state border along route 130. *King 4140.*

Ageratum paleaceum (Gay) Hemsl. var. *nelsonii* Rob.
$n = 10^a$ CHIAPAS: 7 m. e. of the Chiapas-Oaxaca border along route 190. *King 2751.*

Ageratum cf. *paleaceum* (Gay) Hemsl. var. *paleaceum*
$n = 11 \pm 1$ CHIAPAS: 22 m. s. of Las Cruces. *King 3112.*

Ageratum cf. tomentosum (Benth.) Hemsl.
$n = 10$ CHIAPAS: 10 m. e. of the Oaxaca-Chiapas border along route 190. *King 2981.*

Brickellia robinsonii Nels.
$n = 9$ SAN LUIS POTOSI: 2 m. w. of Xilitla. *King 4292.*

Eupatorium cf. *aschenbornianum* Sch.
$n = 20^a$ GUATEMALA: 7 m. w. of Quezaltenango. *King 3182.*

Eupatorium betonicum Hemsl.
$n = 10$ MORELOS: 4 m. w. of Izúcar de Matamoros. *King 2925.*

Eupatorium cf. *gracilicaule* Sch.-Bip.
$n = 10$ CHIAPAS: 24 m. se. of Comitán. *King 3037.*

Eupatorium morifolium P. Miller
$n = 10$ (Fig. 2) SAN LUIS POTOSI: 6 m. ne. of Xilitla. *King 4248.*

Eupatorium petiolare Moc.
$n = 17$ SAN LUIS POTOSI: Near waterfall at El Salto. *King 3919.*
$n = 17$ (Fig. 3) HIDALGO: 5 m. n. of Actopan. *King 4199.*

Eupatorium pycnocephalum Less.
$n = 20$ (Fig. 4) HIDALGO: 12 m. sw. of the Hidalgo-San Luis Potosi state border along route 85. *King 4224.*
$n = 20$ SAN LUIS POTOSI: 6 m. ne. of Xilitla. *King 4242.*
$n = 20$ SAN LUIS POTOSI: near waterfall at El Salto. *King 3875.*
$n = 20$ VERACRUZ: 7 m. s. of Tampico el Alto. *King 4099.*
$n = 20$ VERACRUZ: 10 m. s.

[a] Indicates one to several fragments.

of Cerro Azul. *King 4119.*

$n = 20$ VERACRUZ: 38 m. s. of Acayucan. *King 2452.*

Eupatorium cf. *pycnocephalum* Less.

$n = 10$ (Fig. 5) SAN LUIS POTOSI: 6 m. ne. of Xilitla. *King 4243A.*

Eupatorium quadrangulare DC.

$n = 10$ SAN LUIS POTOSI: near waterfall at El Salto. *King 3853.*

Mikania cf. *gonzalezii* Rob. & Greenm.

$n = 17$ VERACRUZ: 5 m. w. of Tuxpan. *King 4128.*

Oxylobus glanduliferus (Sch.-Bip.) Gray

$n = 16$ GUATEMALA: 4 m. e. of Totonicapan. *King 3216.*

Piqueria pilosa H. B. K.

$n = 12$ MEXICO STATE: 8 m. n. of San Francisco Cheje. *King 3581.*

$n = 12$ (Fig. 6) 9 m. ne. of San Francisco Cheje. *King 3569.*

Piqueria trinervia Cav.

$n = 12$ CHIAPAS: 19 m. e. of San Cristóbal de Las Casas. *King 2821.*

Trichocoronis wrightii Gray

$n = 15$ (Fig. 7) TAMAULIPAS: 2 m. ne. of Altamire. *King 4034.*

ASTEREAE

Aster bimater Standl. & Steyerm.

$n = 5$ GUATEMALA: 6 m. s. of Huehuetenango. *King 3423.*

Aster exilis var. *australis* Gray

$n = 5$ GUATEMALA: 3 m. e. of Quezaltenango. *King 3205.*

$n = 5$ GUATEMALA: 3 m. s. of Huehuetenango. *King 3418.*

$n = 5$ SINALOA: 4 m. w. of El Palmito. *Powell & Edmondson 909.*

Baccharis glutinosa Pers.

$n = 9$ OAXACA: 1 m. n. of Tamazulapan. *King 2935.*

Baccharis serraefolia DC.

$n = 9$ SAN MARCOS: 4 m. e. of San Marcos. *King 3159.*

Chrysopsis cf. *villosa* (Pursh.) Nutt.

$n = 9$ DURANGO: City limits Durango. *King 3725.*

Conyza canadensis L.

$n = 9$ PUEBLA: 20 m. nw. of Tehuacan. *King 2640.*

Conyza coronopifolia H. B. K.

$n = 9$ CHIAPAS: 1 m. e. of San Cristóbal de Las Casas. *King 2838.*

Conyza sophiaefolia H. B. K.

$n = 9$ GUATEMALA: 3 m. e. of Quezaltenango. *King 3206.*

Erigeron delphinifolius Willd.

$n =$ ca. 9 DURANGO: City limits of Durango. *King 3726.*

$n = 9$ DURANGO: 4 km. n. of Durango. *King 3780.*

Erigeron heteromorphus Rob.

$n = 9$ SAN LUIS POTOSI: Waterfall near El Meco. *M. C. Johnston 5116.*

Erigeron cf. *karvinskianus* DC.

$n =$ ca. 27 GUATEMALA: Between Solola and Panajachel. *King 3224.*

Erigeron repens Greenm.

$n = 9$ VERACRUZ: 10 m. s. of Tampico el Alto. *King 4100.*

Erigeron scaposus DC.

$n = 9$ PUEBLA: 0.5 m. sw. of Tehuacan. *King 2311.*

$n = 18$ OAXACA: 6 m. s. of Tamazulapan. *King 2938.*

Erigeron cf. *scaposus* DC.

$n = 18$ MEXICO STATE: 4 m. ne. of San Francisco Cheje. *King 3575.*

Erigeron cf. *scaposus* DC.
$n = 9II + 9I$ MEXICO STATE: 11 m. e. of the Mexico-Michoacan state border along route 15. *King 3597.*
Erigeron cf. *scaposus* DC.
$n = 9$ OAXACA: 21 m. n. of the junction with route 190. *King 3498.*
Erigeron sp.
$n = 9$ TAMAULIPAS: 9 m. s. of Ciudad Victoria. *King 4537.*
Haplopappus stoloniferus DC.
$n = 4$ CHIAPAS: 5 m. e. of San Cristóbal de Las Casas. *King 2805.*
Heterotheca inuloides Cass. var. *inuloides*
$n = 9$ OAXACA: 40 m. se. of Oaxaca. *King 2897.*
Machaeranthera gymnocephala (DC.) Shinners
$n = 4$ DURANGO: 15 m. sw. of Durango. *King 3738.*
$n = 4$ (Fig. 8) MEXICO STATE: 19 m. w. of Toluca. *King 3594.*
Machaeranthera tanacetifolia (H. B. K.) Nees.
$n = 4$ CHIHUAHUA: 14 m. sw. of Chihuahua City. *Powell & Edmondson 976.*
$n = 4$ DURANGO: 13 m. n. of Durango. *King 3754.*
Psilactis asteroides Gray
$n = 4$ DURANGO: City limits of Durango. *King 3728.*
Psilactis cf. *asteroides* Gray
$n = 4$ (Fig. 9) MEXICO STATE: 22 m. w. of Toluca. *King 3595.*
Psilactis brevilingulata Sch.-Bip.
$n =$ ca. 9 (8 II + 2 frags?) MEXICO STATE: 10 m. w. of Toluca. *Powell & Edmondson 799.*
$n = 9$ OAXACA: 6 m. s. of Tamazulapan. *King 2939.*
$n =$ ca. 9 OAXACA: By the ruins at Monte Alban. *King 2899.*
$n =$ ca. 9 QUERETARO: 18 m. s. of San Luis de la Paz. *Powell & Edmondson 573.*
Solidago velutina DC.
$n = 9$ DURANGO: 71 m. ne. of Durango. *King 3762.*
Solidago wrightii Gray
$n = 9$ DURANGO: 24 m. sw. of Durango. *King 3742.*
Xanthocephalum gymnospermoides (Gray) Benth. & Hook.
$n = 6$ CHIHUAHUA: 0.5 m. w. of Cuahutemoc. *Powell & Edmondson 1000.*
Xanthocephalum humile (H.B.K.) Sch.-Bip.
$n = 4$ MEXICO STATE: 12 m. n. of San Francisco Cheje. *King 3586.*
$n = 4$ MEXICO STATE: 42 km. s. of Mexico City. *King 2903.*
$n = 4$ MORELOS: 15 m. n. of Cuernavaca. *Powell & Edmondson 736.*

INULEAE

Gnaphalium leptophyllum DC.
$n = 7$ MEXICO STATE: 8 m. e. of the Mexico-Michoacan state border along route 15. *King 3598.*
$n = 7$ GUATEMALA: Just west of San Marcos. *King 3131.*
Gnaphalium cf. *leptophyllum* DC.
$n =$ ca. 14 GUATEMALA: 1 m. w. of Quezaltenango. *King 3186.*
Pluchea odorata (L.) Cass.
$n = 10$ HIDALGO: 12 m. sw.

of the Hidalgo-San Luis Potosi state border along route 85. *King 4228.*

Pluchea purpurascens (Sw.) DC.

n = 10 NAYARIT: Behind the beach at San Blas. *King 3697.*

HELIANTHEAE

Subtribe Melampodinae

Berlandiera lyrata Benth.

n = 15 DURANGO: City limits of Durango. *King 3730.*

Dugesia mexicana Gray

n = 18 MEXICO STATE: Mexico City area. *Powell & Edmondson 604.*

n = 18 PUEBLA: 14 m. w. of Puebla. *King 3561.*

Parthenium tomentosum DC.

n = 18 OAXACA: 23 m. se. of Oaxaca. *King 3482.*

Polymnia cf. *apus* Blake

n = 16 (Fig. 10) NAYARIT: 1 m. n. of Tepic. *King 3688.*

Polymnia maculata Cav.

n = 16 SAN LUIS POTOSI: 7 m. ne. of Xilitla. *King 4427.*

Polymnia cf. *maculata* Cav.

n = 17 GUATEMALA: 1 m. s. of Coban. *King 3306.*

Polymnia oaxacana Sch.-Bip.

n = ca. 16 GUATAMALA: 2 m. w. of Santa Cruz Verapaz. *King 3338.*

Subtribe Ambrosinae

Ambrosia cf. cumanensis H. B. K.

n = ca. 36 MICHOACAN: 21 m. e. of Jiquilpan. *King 3643.*

Ambrosia peruviana Willd.

n = 18 GUATEMALA: 4 m. s. of Coban. *King 3313.*

SUBTRIBE Zinninae

Heliopsis buphthalmoides (Jacq.) Dunal.

n = 28 GUATEMALA: 9 m. s. of Salama. *King 3263.*

n = ca. 28 CHIAPAS: 10 m. e. of Teopisca. *King 3030.*

Philactis nelsonii (Greenm.) Blake

n = ca. 28 CHIAPAS: 2 m. w. of Chiapas-Oaxaca border along route 190. *King 2878.*

n = 28 CHIAPAS: 21 m. ne. of Las Cruces. *King 3446.*

Sanvitalia cf. *procumbens* Lam.

n = 8 CHIAPAS: 12 m. e. of Cintalapa. *King 2984.*

Sanvitalia procumbens Lam.

n = 8 PUEBLA: 22 m. ne. of Tepeaca. *Powell & Edmondson 639.*

Sanvitalia sp. nov.

n = 8 OAXACA: 1 m. n. of Tamazulapan. *King 2929.*

Tragoceros americanum (Mill.) Blake

n = 11 JALISCO: 16 m. s. of Guadalajara. *King 3658.*

Tragoceros mocinianus Gray

n = ca. 11 JALISCO: 45 m. w. of Sahuayo. *Powell & Edmondson 850.*

Tragoceros schiedeanus Less.

n = 11 JALISCO: 45 m. w. of Sahuayo. *Powell & Edmondson 848.*

Zinnia angustifolia H. B. K.

n = 12 NAYARIT: 8 m. se. of Tepic. *King 3672.*

Zinnia elegans Jacq.

n = 12 GUERRERO: 5 m. n. of Ocotito on the Chilpancingo Acapulco highway. *Johnston 5988.*

Zinnia leucoglossa Blake

n = 11 DURANGO: 14 m. sw. of Durango. *King 3739.*

Zinnia maritima H. B. K.

n = 13 (Fig. 11) GUERRERO: 10 m. e. of Acapulco. *King 4180.*

Zinnia peruviana (L.) L.

$n = 12$ OAXACA: 1 m. se. of Oaxaca. *King 3466.*

Zinnia tenella Rob.

$n = 11$ or 12 DURANGO: 15 m. sw. of Durango. *King 3736.*

SUBTRIBE Verbesininae

Aldama dentata Less.

$n = 17$ OAXACA: 9 m. nw. of Oaxaca. *King 3516.*

$n = 17$ NAYARIT: City limits of Tepic. *King 3668.*

$n = 17$ MORELOS: 5 m. se. of Yautepec. *King 2912.*

$n = 17$ PUEBLA: Just se. of the Morelos-Puebla border. *King 2919.*

$n = 17$ VERACRUZ: 19 m. se. of Poza Rica. *King 4137.*

$n = 17$ VERACRUZ: 1 m. s. of Cuitlahuac. *King 2677.*

$n = 17$ OAXACA: Along route 190, just south of Etla. *King 2509.*

Helianthus laciniatus Gray

$n = 17$ DURANGO: City limits of Durango. *King 3756.*

Hymenostephium sp.

$n =$ ca. 17 NAYARIT: 11 m. se. of Tepic. *King 3675.*

Iostephane heterophylla var. *dicksonii* (Lindl.) Sharp

$n = 17$ (Fig. 12) SINALOA: 1-2 m. sw. of the Sinaloa-Durango border. *King 3721.*

$n = 17$ DURANGO: 24 m. sw. of Durango. *King 3741.*

Iostephane trilobata Hemsl.

$n = 17$ OAXACA: 10 m. ne. of Oaxaca. *Powell & Edmondson 676.*

Jaegeria hirta Less.

$n = 18$ GUATEMALA: Between Solola and Panajachel. *King 3236.*

Jaegeria pedunculata H. & O.

$n = 18$ NAYARIT: 5 m. se. of Tepic. *King 3670.*

Notoptera tequilana (Gray) Blake

$n =$ ca. 15 JALISCO: 26 m. nw. of Tequila. *King 3664.*

Perymenium cf. *asperifolia* Sch.-Bip.

$n =$ ca. 45 OAXACA: 5 m. n. of the junction with route 190. *King 3488.*

Perymenium cf. *chalarolepis* Rob. & Greenm.

$n = 15$ 1 m. w. of San Marcos. *King 3138.*

Podochaenium eminens (Lag.) Sch.-Bip.

$n = 19$ OAXACA: Along route 175, 10 m. n. of the junction with route 190. *King 3494.*

$n = 19$ (Fig. 13) SINALOA: 5 m. sw. of the Sinaloa-Durango border along route 40. *King 3720.*

Rhysolepis sp. nov.

$n = 17$ MICHOACAN: 2 m. e. of Zamora. *King 3645.*

Salmea scandens (L.) DC.

$n = 18^a$ (Fig. 14) SAN LUIS POTOSI: 2 m. w. of Xilitla. *King 4309.*

Sclerocarpus dentatus (Llave & Lex.) Hemsl.

$n = 12$ COAHUILA: 37 m. s. of Monclova. *Powell & Edmondson 506.*

$n = 11$ (Fig. 15) OAXACA: 49 m. w. of Tehuantepec. *King 3458.*

$n = 12$ (Fig. 16) OAXACA: 1 m. ne. of Huajuapan de Leon. *King 3533.*

$n = 12$ TAMAULIPAS: 2 m. ne. of Altamira. *King 4086.*

$n = 12$ VERACRUZ: 4 m. n. of Tampico el Alto. *King 4094.*

$n = 12$ VERACRUZ: 3 m. s.

of Naranjos. *King 4118.*

$n = 12$ SAN LUIS POTOSI: Just north of the San Luis Potosi-Hidalgo state border. *King 4233.*

Sclerocarpus cf. *divaricatus* (Benth.) Hemsl.

$n = 11$ (Fig. 17) VERACRUZ: 20 m. s. of Acayucan. *King 2733.*

Sclerocarpus cf. *frutescens* Brandegee

$n = 12$ (Fig. 18) OAXACA: 1 m. n. of Tamazulapan. *King 2936.*

Sclerocarpus cf. *phyllocephalus* Blake

$n = 11$ GUATEMALA: 4-5 km. w. of Escuintla. *King 3372.*

$n = 11$ (Fig. 19) CHIAPAS: Along the railroad track to Tapachula at the village of Soconusco. *King 3126.*

Sclerocarpus cf. *phyllocephalus* Blake

$n = 12$ CHIAPAS: 5 m. ne. of Las Cruces. *King 3440.*

Sclerocarpus sessilifolius Greenm.

$n = 14$ (Fig. 20) NAYARIT: 8 m. se. of Tepic. *King 3673.*

Spilanthes americana Hieron.

$n =$ ca. 26 SAN LUIS POTOSI: 6 m. ne. of Xilitla. *King 4245.*

$n = 25 \pm 1$ VERACRUZ: 5 m. n. of Tampico el Alto. *King 4092.*

$n =$ ca. 13 PUEBLA: 6 m. sw. of the Puebla-Veracruz state border along route 130. *King 4141.*

$n =$ ca. 26 HIDALGO: 14 m. ne. of Jacala. *King 4222.*

$n = 26^a$ (Fig. 21) VERACRUZ: 9 m. sw. of Tuxpan. *King 4132.*

$n =$ ca. 26 VERACRUZ: 25 m. se. of Poza Rica. *King 4139.*

$n =$ ca. 26 MORELOS: 5 m. se. of Yautepec. *King 2913.*

Spilanthes americana cf. var. *stolonifera* (DC.) Moore

$n =$ ca. 39 MICHOACAN: 21 m. e. of Jiquilpan. *King 3642.*

Tithonia longeradiata (Berl.) Blake

$n = 17$ GUATEMALA: 10 m. s. of Quezaltenango. *King 3428.*

Verbesina crocata (Cav.) Less.

$n = 18$ MORELOS: 11 m. s. of Cuernavaca. *King 4159.*

Verbesina hypargyrea Rob. & Greenm.

$n =$ ca. 17 CHIAPAS: 18 m. se. of Comitán. *King 3044.*

$n = 17$ OAXACA: 41. m. w. of Tehuantepec. *King 3456.*

$n = 17$ COAHUILA: 14 m. s. of Saltillo. *Powell & Edmondson 538.*

Verbesina seatonii Blake

$n = 17$ MEXICO STATE: 9 m. ne. of San Francisco Cheje. *King 3567.*

Viguiera grammatoglossa DC.

$n = 17$ OAXACA: 27 m. n. of the junction along route 190. *King 3504.*

Viguiera longifolia (Rob. & Greenm.) Blake

$n = 8$ CHIAPAS: Wet fields just west of San Cristóbal de Las Casas. *King 2993.*

Wedelia filipes Hemsl.

$n = 11$ GUATEMALA: Near Panajachel. *King 3239.*

$n = 11$ (Fig. 22) GUATEMALA: Near Panajachel. *King 3246.*

Wedelia parviceps Blake

$n = 12$ GUATEMALA: 9 m.

n. of Salama. *King 3283.*

Zexmenia cf. *aurea* (DC.) B. & H.

$n = 10$ (Fig. 23) JALISCO: 17 m. nw. of Tequila. *King 3663.*

Zexmenia costaricensis Benth.

$n = 11$ (Fig. 24) ALTA VERAPAZ: 11 m. w. of San Cristóbal Verapaz. *King 3347.*

Zexmenia pringlei Greenm.

$n = 14$ (Fig. 25) OAXACA: Just s. of the Oaxaca-Puebla border along route 125. *King 3547.*

Zexmenia virgulata Klatt

$n = 11$ (Fig. 26) GUATEMALA: 10 m. s. of Huehuetenango. *King 3392.*

SUBTRIBE Coreopsidinae

Coreopsis mutica DC.

$n =$ ca. 26 CHIAPAS: 13 m. e. of San Cristóbal de Las Casas. *King 2813.*

$n =$ ca. 24 CHIAPAS: 14 m. w. of San Cristóbal de Las Casas. *King 3082.*

Cosmos diversifolius Otto

$n = 12$ OAXACA: 30 m. nw. of Oaxaca. *King 3525.*

$n = 12$ OAXACA: 29 m. nw. of Oaxaca. *King 3523.*

Dahlia dissecta S. Wats.

$n = 18$ MEXICO STATE: Savannah-like forest on route 190 at Llano Grande. *Rock M-351.*

Dahlia scapigera (A. Dietr.) L. & O.

$n = 18$ PUEBLA: 14 m. w. of Texmelucan. *King 3564.*

SUBTRIBE Galinsoginae

Calea integrifolia (DC.) Hemsl.

$n =$ ca. 16 PUEBLA: 5 m. ne. of Villa Juarez. *King 4143.*

Calea nelsonii Rob. & Greenm.

$n =$ ca. 18 CHIAPAS: 10 m. e. of the Oaxaca-Chiapas border. *King 2982.*

Calea cf. *trichotoma* D. Smith

$n = 18$ CHIAPAS: 23 m. se. of Comitán. *King 3043.*

Galinsoga parviflora Cav.

$n =$ ca. 16 CHIAPAS: Just w. of San Cristóbal de Las Casas. *King 2991.*

$n = 16$ GUATEMALA: Along National Route 1, between Solola and Panajachel. *King 3225.*

$n = 16$ GUATEMALA: Along National Route 1, between Solola and Panajachel. *King 3235.*

$n = 16$ MICHOACAN: 2 m. n. of Zitacuaro. *King 3603.*

$n = 16$ MICHOACAN: 5 m. w. of Morelia. *Powell & Edmondson 825.*

$n = 16$ OAXACA: 12 m. ne. of Oaxaca. *Powell & Edmondson 684.*

$n = 8$ MEXICO: 10 m. w. of Toluca. *Powell & Edmondson 804.*

$n = 8$ PUEBLA: 10 m. e. of Puebla. *Powell & Edmondson 624.*

Sabazia sp. nov.

$n = 8$ (Fig. 27) OAXACA: 21 m. n. of the junction with route 190. *King 3499.*

HELENIEAE

Galeana pratensis (H. B. K.) Rydb.

$n = 9$ (Fig. 28) JALISCO: 12 m. nw. Guadalajara. *King 3661.*

$n = 9$ GUATEMALA: 15 m. s. of Rabinal. *King 3363.*

Schkuhria anthemoides var. *wislizeni* (Gray) Heiser

$n = 20$ (Fig. 29) OAXACA: 17 m. se. of Nochistlan. *King 3527.*

Schkuhria pinnata var. *virgata* (Llave) Heiser
$n = 21 \pm 1$ GUATEMALA: 8 m. s. of Huehuetenango. *King 3426.*
$n =$ ca. 20 GUATEMALA: 1 m. s. of Huehuetenango. *King 3413.*

Perityle microglossa Benth.
$n =$ ca. 46 ± 4 SAN LUIS POTOSI: Near the waterfall at El Salto. *King 3877.*

ANTHEMIDEAE

Chrysanthemum parthenium Benth.
$n = 9$ OAXACA: 10 m. n. of the junction with route 190. *King 3495.*

SENECIONEAE

Neurolaena lobata (L.) R. Br.
$n = 11$ (Fig. 30) SAN LUIS POTOSI: 2 m. w. of Xilitla. *King 4276.*

Schistocarpha bicolor Less.
$n = 8$ VERACRUZ: 5 m. ne. of Villa Juarez. *King 4144.*
$n = 8$ HIDALGO: 9 m. sw. of the Hidalgo-San Luis Potosi state border along route 85. *King 4230.*
$n = 8$ SAN LUIS POTOSI: 6 m. generally ne. of Xilitla. *King 4241.*

Senecio cobanensis var. *sublanciniatus* Greenm.
$n =$ ca. 65 GUATEMALA: 11 m. s. of Salama. *King 3270.*

Senecio confusus Britton
$n = 45 \pm 5$ SAN LUIS POTOSI: 2-3 m. w. of El Naranjo. *King 3973.*

Senecio conzatii Greenm.
$n = 20$ OAXACA: Along route 175, 12 m. n. of the junction with route 190. *King 3496.*

Senecio deformis Klatt
$n =$ ca. 20 DISTRITO FEDERAL: El Zarco on route 15, outside Mexico City. *Rock M-412.*
$n = 20$ MEXICO STATE: 8 m. n .of San Francisco Cheje. *King 3583.*
$n = 20$ MEXICO STATE: 11 m. e. of the Mexico-Michoacan state border along route 15. *King 3596.*

Senecio hirsuticaulis Greenm.
$n = 30$ SAN LUIS POTOSI: 17 m. e. of Ciudad del Maiz. *Johnston 5104.*

Senecio imparipinnatus Klatt
$n =$ ca. 23 (Fig. 31) TAMAULIPAS: 4 m. s. of Ciudad Monte. *King 3845.*

Senecio picridis Schaur.
$n = 20$ GUATEMALA: 11 m. w. of Quezaltenango. *King 3191.*
$n = 20$ MORELOS: 3 m. s. of the Morelos-Federal District border along route 95. *King 4151.*

Senecio salignus DC.
$n = 30$ HIDALGO: 1 m. e. of Pachuca. *King 4148.*
$n = 30$ MEXICO STATE: 9 m. sw. of the pyramids at Teotihuacan. *King 4149.*

Senecio toluccanus DC.
$n = 20$ MEXICO STATE: 9 m. ne. of San Francisco Cheje. *King 3574.*

Cacalia sp.
$n =$ ca. 30 JALISCO: 21 m. se. of Guadalajara. *King 3656.*

Cacalia sinuata Llave & Lex.
$n = 30$ DURANGO: 6 m. sw. of Durango. *King 3734.*

Cacalia cf. *tussilaginoides* H. B. K.
$n =$ ca. 25 JALISCO: 3 m. nw. of Guadalajara. *King 3659.*

ARCTOTIDEAE

Arctotis stoechadifolia Berk.
$n = 9$ (Fig. 32) GUATEMALA: 6 m. ne. of Quezaltenango. *King 3210.*

MUTISIEAE

Trixis californica Kellogg
$n = 27$ CHIHUAHUA: 30 m. w. of Chihuahua City. *Powell & Edmondson 1004.*

Trixis radialis (L.) Kuntze
$n =$ ca. 27 CHIAPAS: 9 m. e. of Tuxtla Gutierrez. *King 2768.*

$n = 27$ SAN LUIS POTOSI: Near the waterfall at El Salto. *King 3904.*

$n = 27$ (Fig. 33) SAN LUIS POTOSI: 2 m. w. of Xilitla. *King 4291.*

CICHORIEAE

Lactuca pulchella (Pursh) DC.
$n = 17$ GUATEMALA: 9 m. w. of San Cristóbal Verapaz. *King 3346.*

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CHROMOSOME NUMBERS IN MEXICAN AND GUATEMALAN COMPOSITAE[1]

J. H. BEAMAN AND B. L. TURNER

The chromosome numbers reported here were obtained from bud material collected by Beaman in the summer of 1960. The counts were made by Turner (except in *Seigesbeckia* which Beaman examined) from pollen mother cell squashes as outlined by Turner and Ellison (1960). The voucher specimens were determined by Beaman, except

[1]Supported by National Science Foundation grants G-9025 and G-9045.

Helianthella quinquenervis which was determined by Dr. C. B. Heiser, Jr., and they are deposited in the Michigan State University Herbarium. A nearly complete set is also in the Herbarium of the University of Texas. All material studied is listed in Table 1.

DISCUSSION

EUPATORIEAE — *Piqueria pilosa* ($n=12$). Turner, Powell, and King (1962) reported two other collections of this species as $n=12$.

ASTEREAE — *Erigeron coronarius* ($n=18$). Diploid counts of $n=9$ were obtained by De Jong and Longpre (unpublished) in two Durango collections of this species. *E. coronarius* as presently understood is polymorphic, and further study may indicate that the variations are correlated with chromosomal races.

Xanthocephalum linearifolium ($n=4$). The count in this collection was noted by Solbrig (1961) who reported counts for three species of *Xanthocephalum*.

HELIANTHEAE — *Bidens triplinervia* var. *macrantha* ($n=12$). Tetraploid and hexaploid populations of this widely distributed and variable taxon occur on the Guatemalan volcanoes of Pleistocene or recent age (Beaman, De Jong, and Stoutamire, 1962). This diploid material comes from the older, non-volcanic Sierra de los Cuchumatanes.

Jaegeria petiolaris ($n=9$). Turner, Powell and King (1962) have found two other species (*J. pedunculata* Hook. & Arn. and *J. hirta* Less.) with $n=18$. The present report establishes the tetraploid nature of the other counts.

Calea sp. ? ($n=16$). Turner et al. (1961 (1962) have reported approximate counts of $n=16$, 17, and 18 for several other species, and they have obtained a definitive count for only one species, *C. trichotoma* with $n=18$. The generic determination of our material may possibly be in error; if it belongs to the genus *Calea*, it is apparently undescribed.

Siegesbeckia nudicaulis ($n=15$), *S. repens* ($n=15$), *S. triangularis* ($n=15$). The first two of these species are very restricted endemics, while the latter is more widespread and may be conspecific with *S. orientalis (sens. lat.)* in which Diers (1961) found $n=15$.

HELENIEAE — *Microspermum debile* ($n=12$). This is the first count reported in this small and little collected genus.

SENECIONEAE — *Werneria nubigena* ($n=50$). Counts in 13 species of *Werneria*, including a count of $2n=212\pm8$ in *W. nubigena*, were reported by Diers (1961). All but one species he investigated had somatic numbers of 100 or higher.

SUMMARY

Meiotic chromosome counts are reported for 25 species of

Mexican and Guatemalan Compositae. These include the first counts published for 16 taxa. The first report is given for the genus *Microspermum* (n=12). A count of n=9 was found for *Jaegeria petiolaris*, thus establishing the tetraploid nature of previous chromosome reports of n=18 for this genus. Numbers consistent with established basic numbers or previously reported counts were found in *Piqueria, Erigeron, Grindelia, Heterotheca, Xanthocephalum, Helianthella, Sanvitalia, Siegesbeckia, Viguiera, Florestina, Helenium, Cacalia, Senecio, Cirsium*, and *Hieracium*. Numbers differing with previously reported counts or basic numbers were obtained in *Bidens triplinervia* var. *macrantha* (n=12), *Calea* sp. ? (n=16), and *Werneria nubigena* (n=50).

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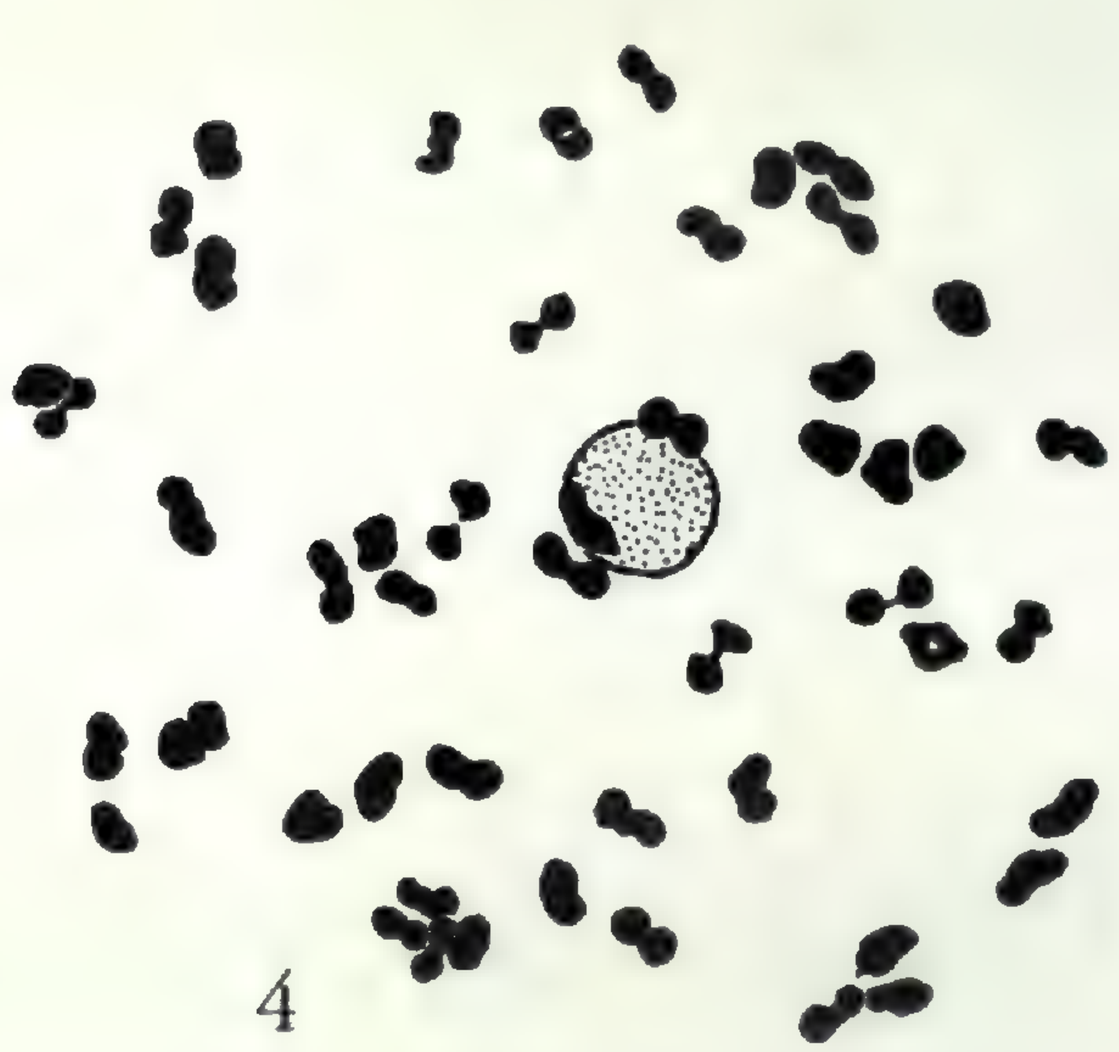

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Figs. 1-4. Meiotic chromosomes of selected species, approximately × 2000. Fig. 1. *Jaegeria petiolaris* (n=9). Fig. 2. *Calea* sp. ? (n=16). Fig. 3. *Microspermum debile* (n=12). Fig. 4. *Werneria nubigena* (n=50).

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TABLE 1. Summary of collections studied.

Taxon	Locality	*n* chromosome number
EUPATORIEAE		
Piqueria pilosa H.B.K.	State of Mexico. Nevado de Toluca, northwest side of mtn., *ca.* 3715 m. alt. *Beaman 3471.*	12
ASTEREAE		
Erigeron coronarius Greene	State of Mexico. 5 kilometers north of Atlacomulco, *ca.* 2500 m. alt. *Beaman 3370.*	18
E. scaposus DC.	State of Mexico. 6 kilometers north of Atlacomulco; *ca.* 2500 m. alt. *Beaman 3358a.*	18
Grindelia inuloides Willd.	Nuevo Leon. Cerro Potosí, summit of mtn., *ca.* 3650 m. alt. *Beaman 3346.*	6
Heterotheca inuloides Cass. var. *inuloides*	State of Mexico. 3 kilometers southeast of Amecameca; *ca.* 2500 m. alt. *Beaman 3474.*	9
Xanthocephalum linearifolium (DC.) Greenman	Distrito Federal, Mexico. At La Cima Station between Mexico and Cuernavaca, 3035 m. alt. *Beaman 3653.*	4

HELIANTHEAE

Bidens triplinervia var. *macrantha* (Wedd.) Sherff	Guatemala. Dept. of Huehuetenango. Between Tojiah and Chemal at Km. 319.5 on Ruta Nacional 9 N, *ca.* 3380 m. alt. *Beaman 3743.*	12
Helianthella quinquenervis (Hook.) A. Gray	Nuevo Leon. Cerro Potosí, near summit of mtn. on northeast side, *ca.* 3600 m. alt. *Beaman 3339.*	15
Jaegeria petiolaris Robins.	Michoacan. In large llano *ca.* 4 kms. southeast of Cerro San Andres, *ca.* 10 kms. (straight line distance) north of Ciudad Hidalgo, *ca.* 2930 m. alt. *Beaman 4245.*	9 (Fig. 1)
Calea sp. ?	Guatemala. Dept. of Huehuetanango. Between Tojiah and San Juan Ixcoy at Km. 323.5 on Ruta Nacional 9 N, *ca.* 3200 m. alt. *Beaman 3956.*	16 (Fig. 2)
Sanvitalia procumbens Lam.	Puebla. 1.5 miles west of Chachapa, *ca.* 2300 m. alt. *Beaman 3615.*	8
Siegesbeckia nudicaulis Standl. & Steyerm.	Guatemala. Dept. of Huehuetenango, between Tojiah and San Juan Ixcoy at Km. 324.5 on Ruta Nacional 9 N, *ca.* 3140 m. alt. *Beaman 3844.*	15
S. repens Robins. & Greenm.	Oaxaca. Llano de las Flores, on the Oaxaca-Valle Nacional highway 20 kilometers east of Ixtlan, *ca.* 2870 m. alt. *Beaman 3699.*	15
S. triangularis Cav.	Guatemala. Dept. of Huehuetenango, between Tojiah and San Juan Ixcoy at Km. 323.5 on Ruta Nacional 9 N, *ca.* 3200 m. alt. *Beaman 3849.*	15
Viguiera hemsleyana Blake	Oaxaca. On the Oaxaca-Valle Nacional highway, 8 miles east of Ixtlan, *ca.* 3600 m. alt. *Beaman 3662.*	ca 34

HELENIEAE

Florestina pedata (Cav.) Cass.	Puebla. 1.5 miles west of Chachapa, *ca.* 2300 m. alt. *Beaman 3616.*	10
Helenium hoopesii A. Gray	Nuevo Leon. Cerro Potosí, sum-	15

	mit of mtn., *ca.* 3650 m. alt. *Beaman 3347.*	
Microspermum debile Benth.	Oaxaca. On the Oaxaca-Valle Nacional highway, on Cerro Pelong, 25.5 miles east of Ixtlan, *ca.* 2950 m. alt. *Beaman 3663.*	12 (Fig. 3)
SENECIONEAE		
Cacalia peltata H.B.K.	Puebla. 5.3 miles southwest of San Salvador el Seco; *ca.* 2500 m. alt. *Beaman 3619.*	30
Senecio conzattii Greenm.	Oaxaca. Llano de las Flores, on the Oaxaca-Valle Nacional highway 20 kms. east of Ixtlan, *ca.* 2870 m. alt. *Beaman 3700.*	20
S. iodanthus Greenm.	Michoacan. Summit of Cerro San Andres, *ca.* 12 kms. (straight line distance) north of Ciudad Hidalgo, 3589 m. alt. *Beaman 4241.*	20
Werneria nubigena H.B.K.	Guatemala. Dept. of Huehuetenango. Between Tojiah and Chemal at Km. 319.5 on Ruta Nacional 9 N, *ca.* 3380 m. alt. *Beaman 3741.*	50 (Fig. 4)
CYNAREAE		
Cirsium skutchii Blake	Guatemala. Dept. of Huehuetenango. Between Tojiah and Chemal at Km. 319.5 on Ruta Nacional 9 N, *ca.* 3380 m. alt. *Beaman 3742.*	17
CICHORIEAE		
Hieracium mexicanum Less.	State of Mexico. Iztaccihuatl, south side of mtn. at La Joya, *ca.* 3990 m. alt. *Beaman 3501.*	9
H. selerianum Zahn	Guatemala. Dept. of Huehuetenango. Between Tojiah and Chemal at Km. 317.5 on Ruta Nacional 9 N, *ca.* 3400 m. alt. *Beaman 3802.*	9

CHROMOSOME COUNTS OF TWO THYMELAEACEAE

LORIN I. NEVLING, JR.

The earliest reports of chromosome numbers in the Thymelaeaceae were published shortly after the turn of this century, as incidental remarks, in discussions of endosperm formation, embryo sac development, and parthenogenesis. Chromosome numbers for nearly forty taxa, in seven genera, have been reported, a small percentage considering that several hundred species in fifty-five genera are recognized. The authors of these reports understandably have had little interest in the family as a group and, therefore, rarely have correlated their data with the taxonomic system. Domke's (1934) realignment of the classification down to the generic level has increased taxonomic interest and research of both the revisionary and floristic types. His broad study is based primarily on anatomy and morphology and makes no attempt to include the meager cytological data then available. There have been few opportunities, since that time, to profitably apply cytological information to taxonomic problems because of the nature of the groups under study, i.e., revisionary investigations have been limited to genera which are cytologically unknown.

Although the chromosome counts are restricted, with a few exceptions, to the larger and more accessible genera, i.e., *Daphne, Pimelea,* and *Wikstroemia,* even these few reports have demonstrated an interesting biological complexity to the family and some of the accompanying taxonomic consequences. Horticulturists, cytologists, and taxonomists, for example, for considerable time have known *Daphne odora* Thunb. to be sterile. Osawa (1913) attempted to explain this lack of seed development but he misdetermined the chromosome number and succeeded only in precipitating a series of papers on the subject. Okura and Kono only recently (1959) elucidated fully the cytological situation (allotriploidy) which is the basis of the sterility. Cruickshank (1953) discovered, in the Australasian genus *Pimelea,* an interesting polyploid series ranging from diploid to hexaploid species, some gynodioecious, others dioecious,

which will have to be given serious consideration when that group is revised. Apogamy has been reported in the taxonomically troublesome genus *Wikstroemia*, a genus closely related to, if not congeneric with *Daphne*. It is suspected in a number of species on the basis of aborted pollen but has been demonstrated only in *W. indica* C. A. Mey. (Fagerlind, 1940). Some of the difficulties in this genus may stem from this phenomenon. There has been a recent trend toward reporting chromosome numbers and coördinately shifting or erecting additional taxonomic categories to accommodate newly uncovered chromosome-number patterns. This procedure, often accomplished with complete disregard for other factual data and lacking overall perspective of the taxonomic continuity of the group, while hailed in some quarters as a "miracle drug" to "cure" taxonomy is, in reality, a placebo.

It is difficult to obtain living material of this family, excepting the horticulturally important species of the genus *Daphne*. Observations of cytological importance can be made only on living material, necessitating the accumulation of this type of data whenever it is available. During the past year I have been fortunate to obtain living material of *Daphne blagayana* Freyer, an Old World species, and *Daphnopsis americana* (Mill.) J. R. Johnston, a New World species. Somatic chromosome numbers for these species are reported here for the first time.

Daphne blagayana Freyer, $2n = 18$ (*Nevling 101*, A). This low, spreading, Old World species with handsome terminal inflorescences of creamy white flowers (see Curtis Bot. Mag. **124:** *t. 7579*. 1898) is native to subalpine woods of Roumania, Hungary, Yugoslavia, Albania, and Bulgaria. It is related to several other species of horticultural interest such as *D. collina* Smith, *D. sericea* Vahl, and *D. petraea* Leybold. In Europe it is cultivated and considered to have two "forms" (Hodgkin, 1961) one of which flowers two weeks earlier (March in Great Britain) than the other. During the fall of 1961, the Arnold Arboretum was fortunate to receive six rooted shoots from the Arboretum Volcji Potok, Radomlje, Yugoslavia. These shoots were collected

from wild plants which had layered naturally in a habitat of perpetual shade on the cool, moist, north-facing slopes of low hills.

Inasmuch as pollen mother cells were not available for examination, root tips were selected, placed in a saturated aquaeous solution of paradichlorobenzene for two hours, rinsed, fixed in three parts absolute ethyl alcohol and one part glacial acetic acid for 30 minutes; hydrolized in 1 N. hydrochloric acid at 55° C. for 20 minutes, rinsed, stained in leuco-basic fuchsin for two hours and squashed. In such preparations a somatic chromosome number of 18 was observed repeatedly. All stages in division were observable.

It may seem unusual that the chromosome number of this well-known species has not been reported previously as there are several papers devoted to its embryo-sac development. These papers, however, are pre-1900, and apparently little attention has been given this species in recent years, except by horticulturists. The chromosome number $2n = 18$ has been reported for nine of ten species of *Daphne*, the only exception being the previously mentioned *D. odora*, a triploid.

Daphnopsis americana (Mill.) J. R. Johnston, $2n = 18$ (*Nevling 102*, A). This New World species of dioecious, small trees is distinguished from other members of the genus by the large, dichotomously branching, terminal inflorescences. It is the most widespread and complex of the genus *Daphnopsis* with seven subspecies (Nevling, 1959). *Daphnopsis americana* ssp. *caribaea* (Griseb.) Nevl. has the most extensive geographical distribution of any of the subspecies, ranging from Nicaragua south through Costa Rica and Panama to Colombia, eastward across northern Venezuela, and north through the Lesser Antilles to Puerto Rico. Immature fruiting material of this subspecies (*R. & E. Howard 15258*, A) was collected, in 1960, from an isolated tree, on a rockslide, on the north slope of Mt. Eagle, St. Croix. Cuttings and mature fruiting inflorescences from this isolated tree were forwarded in February, 1961. The pure white drupes were ovoid, about 8 mm. long and 6 mm. in diameter with a fleshy outer layer and an inner fibrous

one. The extensive fleshy layer, containing compound rhomboidal crystals of calcium oxalate, is lost in the drying process of preparing herbarium specimens. The pseudomonomeric ovary contains a single bi-integumented ovule; the inner integument forms a dark, hard, seed coat while the outer integument forms an outer membranaceous layer. All cuttings failed to strike but a half-dozen seedlings were obtained from less than a dozen seeds, the first germinating in two and one-half months and the last after five months. The sex of seedling plants has not yet been determined.

Root tips from the seedlings were examined cytologically after various methods of treatment, including that used for *Daphne blagayana*. Except for the treatment outlined below, the chromosomes were unsuitable for study due to insufficient chromosomal contraction and poor staining. Root tips were placed in water at 10° C. for 15 hours, fixed and hydrolized as in *Daphne blagayana*, rinsed, stained and squashed in aceto-carmine. A somatic chromosome number of 18 was observed repeatedly, with all stages of division being observable and appearing normal. Since this is the first chromosome count to be reported for a member of the Thymelaeaceae from the New World it is interesting to note that it fits the base number of nine as previously reported in the family.

I am indebted to Ing. Igo Oraš, Director *Emeritus* of the Volcji Potok Arboretum, for plants of *Daphne blagayana*, and to Mr. A. J. Oakes, Research Agronomist of St. Croix, for cuttings and fruits of *Daphnopsis americana* ssp. *caribaea*. The editorial suggestions of Drs. C. E. Wood, Jr., and W. R. Ernst, which have substantially contributed to the organization of this note, are appreciated by the author. Special thanks are due to Mr. Alfred Fordham, Propagator of the Arnold Arboretum, for his sympathetic handling of the research materials, without which this paper would not be possible. — ARNOLD ARBORETUM, HARVARD UNIVERSITY.

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Chromosome Number in Striped and Mountain Maples. — Striped maple (*Acer pensylvanicum* L.) and mountain maple (*Acer spicatum* Lam.) are both common species throughout the Northeast. Their ranges, which extend west to Minnesota and south in the mountains to northern Georgia, are similar. Although both species may attain small tree size, they are of little commercial importance for timber and have attracted only mild interest as ornamentals. Neither species has been investigated cytologically.

The writer has collected both species for chromosome studies from several northern localities. Striped maple collections were from Mifflin and Luzerne Counties in Pennsylvania, and Hampshire County, Massachusetts. Mountain maple was collected in Hennepin County, Minnesota; Delaware County, Pennsylvania; and Middlesex County, Massachusetts.

Entire inflorescences were removed from the trees during the spring, and were fixed for 24 hours in 3:1 alcohol-acetic with a few drops of ferric chloride added. Storage was in 75 percent ethyl alcohol at 10°C. Standard aceto-carmine smear techniques on pollen mother cells were used in the chromosome studies.

It was found that, for both species, meiosis took place before the bud scales had fully separated. Chromosome

counts for all material gave n = 13, and no marked meiotic irregularities were noted. Thus both species appear to be diploid over the northern portion of their ranges.

Of the 10 species of maple native to the United States for which chromosome numbers are now available, 8 are diploid and only red and silver maples are polyploid. — FRANK S. SANTAMOUR, JR. GENETICIST, NORTHEASTERN FOREST EXPERIMENT STATION, U. S. FOREST SERVICE, STATIONED AT MORRIS ARBORETUM, PHILADELPHIA, PA., IN COOPERATION WITH THE UNIVERSITY OF PENNSYLVANIA.

ILLINOIS FLORA: NOTES ON LIMNOSCIADIUM, DICLIPTERA, AND IRESINE. — During recent field work I found one of the Umbelliferae that is new to the Illinois flora, an additional stand of *Dicliptera brachiata* (Pursh) Spreng., and one of *Iresine rhizomatosa* Standl., both species rare in Illinois.

Limnosciadium pinnatum (DC.) Math. & Const. is a plant of wet places that ranges from Louisiana and Texas, north to southeastern Kansas and southwestern Missouri. On July 14, 1960, I spent some time collecting plants east of Fayetteville, a small community in southeastern St. Clair County, about 25 miles southeast of East St. Louis. One of my collections from a roadside ditch east of the Kaskaskia River was *Limnosciadium pinnatum*.[1] This site is almost 300 miles northeast of the range in southwestern Missouri. Herbarium specimens, in the herbarium of the Illinois Natural History Survey (ILLS) and the University of California (UC), have the following label data:

Roadside ditch, east of Fayetteville, St. Clair County, Illinois, July 14, 1960, *R. A. Evers* 65864.

In a previous article (Rhodora 58:49-50) I reported the occurrence of *Dicliptera brachiata* in southern Illinois, east of Joppa, Massac County. That collection was made in 1951. On subsequent trips to this locality I failed to find this species but did discover a stand of another plant rare in

[1]I wish to thank Dr. Lincoln Constance, University of California, Berkeley, for identifying the specimen.

Illinois, *Iresine rhizomatosa*. On September 2, 1960,while botanizing the bluffs and floodplain of the Ohio River east of Cave-in-Rock, Hardin County, I found a sizable stand of *D. brachiata* at the base of the bluff. This locality, the second for this species in Illinois, lies over 40 miles northeast of the Massac County site. On October 12, 1961, I revisited the ravine east of Joppa and once more collected *D. brachiata*. The two recent collections have the following label data:

Base of wooded bluffs, east of Cave-in-Rock, Hardin County, Illinois, September 2, 1960, *R. A. Evers* 67398. Wooded ravine, east of Joppa, Massac County, Illinois, October 12, 1961, *R. A. Evers* 72015.

The herbarium sheets of *Iresine rhizomatosa* in the Survey herbarium have the following data:

Wooded ravine, east of Joppa, Massac County, Illinois, September 23, 1952, *R. A. Evers* 35975; September 12, 1961, *R. A. Evers* 71286.

This species formed a colony about one meter in diameter and was very conspicuous along the bank of the intermittent stream in the ravine. — ROBERT A. EVERS, ILLINOIS NATURAL HISTORY SURVEY, URBANA.

ZIZANIOPSIS MILIACEA FROM ILLINOIS. — The robust, perennial, aquatic grass *Zizaniopsis miliacea* (Michx.) Döll & Aschers. has not been previously reported as an established species in Illinois according to information available to the writer. The natural range of this southern wild rice or water-millet is through most of the southern and southeastern states including Tennessee, Kentucky and Missouri. The present locality of the Illinois station for *Zizaniopsis miliacea* is in Montgomery County near Hillsboro. In this locality the plants grow in marginal patches and isolated clumps in shallow water around the shore of Lake Hillsboro. The first specimens were called to the writer's attention by Mr. A. C. Lopinot of the Illinois Department of Conservation. Mr. Lopinot requested identification of the broad-

leaved grass which he found growing with *Typha latifolia* and *Leersia oryzoides.*

Lake Hillsboro is an artificial lake of about 100 acres created in 1917 as a source of water supply for the town. Mr. Paul Graden of Hillsboro revealed that the grass, *Z. miliacea,* had been growing, to his knowledge, around the lake for perhaps 20 years. Further inquiry did not reveal how the original plants or seeds arrived or if they had been planted; but they are certainly persisting, and continued survival seems likely. We do not know if this grass arrived in the locality by natural or other means, and the fact that it has persisted and become naturalized seems worthy of reporting. Only a few culms bore inflorescences and, growing as it does with *Typha latifolia,* it may have been easily overlooked. Verification of identity was made by Dr. Jason Swallen. Specimens are deposited in herbaria of the following: Illinois State Museum, Springfield, Illinois Natural History Survey, Urbana, and the U. S. National Museum, Washington. Collection data ase are follows: Montgomery Co., Illinois, near Hillsboro. Shallow water along the margin of an artificial lake. Oct. 4, 1961, *G. S. Winterringer, 18526, 18527* (ISM), *18515* (US), and *18516* (ILLS). — GLEN S. WINTERRINGER, ILLINOIS STATE MUSEUM, SPRINGFIELD.

A NOTE ON THE ASCRIPTION OF ELYMUS ARENARIUS TO ILLINOIS. — In recording the recent discovery of *Elymus arenarius* in Wisconsin (Rhodora 62: 199-201, 1960), the authors say "The taxonomic confusion surrounding *Elymus mollis* and *E. arenarius* has been carefully and thoroughly elucidated by Bowden (1957). All Illinois collections of *E. mollis* cited by Jones (1955), who followed Hitchcock & Chase (1950) are *E. arenarius.*"

There is, so far as I am aware, no taxonomic confusion surrounding *E. mollis,* an American species, and the Eurasian *E. arenarius,* although it is a fact that some specimens of the latter species sometimes have been misidentified as *E. mollis.* As early as 1918 Miss Edna Mosher had correctly

named the grass as *E. arenarius*, and cited what is so far as I know the first collection of it in Illinois: "Wilmette, *Killip*, June 1916." This report was repeated by Pepoon in 1927.

Of course, like practically everyone else who has written anything on Gramineae of the United States during the last quarter of a century, we generally "followed" Hitchcock or Hitchcock & Chase. In this instance, however, the reference is not particularly apt, as instead of "following" Hitchcock & Chase we pointed out the true taxonomic identity of the European lyme-grass that is establishing itself on sand dunes around the south end of Lake Michigan. This identity was abundantly proved and demonstrated by the Canadian botanist, Dr. W. M. Bowden, two years later. — G. NEVILLE JONES, UNIVERSITY OF ILLINOIS, URBANA.

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STUDIES IN THE IRIDACEAE, VII

ROBERT C. FOSTER[1]

INTRODUCTION

In view of the fact that the genera *Mastigostyla* and *Cardenanthus* have been treated piecemeal by me in three different publications, it seems desirable to give them unified treatments, with complete keys, and adding two more species to *Mastigostyla*. A treatment of *Anomalostylus*, fuller than that given in the original publication, is included. Finally, there are some notes on the genus *Trimezia*, with the description of two new species, some miscellaneous notes, and descriptions of three novelties in the genus *Sisyrinchium*.

Aside from specimens in the Gray Herbarium (GH), material has been seen from the U. S. National Herbarium (US), the New York Botanical Garden (NY), the Missouri Botanical Garden (MBG), the Chicago Natural History Museum (F), the University of California (UCAL), and the Academy of Natural Sciences of Philadelphia (PHIL). To the administrative officers of these herbaria, I am indebted for the opportunity of seeing this material.

1. MASTIGOSTYLA I. M. JOHNST.

Reasons for believing *Mastigostyla* distinct from *Cypella* were given in detail in Contrib. Gray Herb. no. 155: 22-23 (1945). Additional material, both of *Mastigostyla* and *Cypella*, seen since that time has strengthened the view there

[1]Gray Herbarium, Harvard University.

expressed. This may be recapitulated briefly as follows: *Mastigostyla* has a short but definite perianth-tube, with the base of the flower infundibuliform; the long stamen-filaments are either completely united or nearly so, while the anthers are free from the style; the style-arms are bifid to a point well below the stigmas; the inner tepals are greatly reduced, far more so, proportionately, than in any species of *Cypella*.

Mastigostyla I. M. Johnst. in Contrib. Gray Herb. (n. s.) no. 81: 85 (1928); Diels in Engler & Prantl, Nat. Pflanzenfam. (ed. 2) **15a:** 498 (1930), as synonym of *Cypella;* Macbride in Field Mus. Pub. Bot. **13:** 716 (1936), as synonym of *Cypella;* Foster in Contrib. Gray Herb. no. 155: 22-23 (1945) and no. 161: 15 (1946).

Bulbous, caulescent or acaulescent herbs. Basal leaves few, linear; cauline leaves 1-2. Stem simple or branched. Spathes firm-textured, usually subequal, or the outer shorter, 1-4-flowered, the slender pedicels usually not exserted at anthesis. Flowers infundibuliform at the base, with a short perianth-tube (usually 2 mm. long); the two series of tepals markedly dissimilar in size and shape, the outer larger than the inner. Stamen-filaments united in a column, the anthers sessile, or nearly so, on the column, opposite the style-arms. Style as long as the column, more or less wing-margined above; style-arms bifid below the transverse stigmas, the crests (2 per style-arm) more or less petaloid or flagelliform, decurrent on the abaxial faces of the style-arms. Capsule oblong-ellipsoid; seeds small, angulate.

Type-species: *M. cyrtophylla* I. M. Johnst.

KEY

a. Length of style, style-arms and -crests less than 15 mm.
  b. Spathes immediately subtended by 1-2 cauline leaves.
    c. Spathes subtended by 2 cauline leaves; style-crests 0.5 mm. long; inner tepals oblanceolate, 8 mm. long; Argentina..... ..... 1. *M. Cabrerae.*
    c. Spathes subtended by 1 cauline leaf; style-crests 1-2.5 mm. long; Bolivia.
      d. Style-crests 1 mm. long; inner tepals linear or narrowly elliptic, 7 mm. long, not over 1 mm. wide. 2. *M. brevicaulis.*
      d. Style-crests about 2.5 mm. long; inner tepals ovate, 5.5 mm. long, 2.5 mm. wide. ..... 3. *M. potosina.*
  b. Spathes not subtended by cauline leaves. ..... 4. *M. Johnstonii.*
a. Length of style, style-arms and -crests more than 15 mm.
  e. Spathes subtended by cauline leaves, the plants appearing acaulescent. ..... 5. *M. Hoppii.*
  e. Spathes not subtended by cauline leaves, the plants obviously caulescent.
    f. Style-crests more or less flagelliform, more than 2 mm. long.

g. Spathes ventricose; inner tepals to 1.4 cm. long. .....
..... 6. *M. cyrtophylla.*
g. Spathes not ventricose; inner tepals shorter.
h. Outer tepals obovate-spatulate, 3 cm. long; inner tepals oblanceolate.
i. Basal leaves to 50 cm. long, 4 mm. wide; inner tepals 1 cm. long. ..... 7. *M. gracilis.*
i. Basal leaves to 29 cm. long, 1-2 mm. wide; inner tepals 7 mm. long. ..... 8. *M. Joergensenii.*
h. Outer tepals oblong, to 2.2 cm. long; inner tepals narrowly elliptic. .... 9. *M. peruviana.*
f. Style-crests elliptic-lanceolate, 2 mm. long. .. 10. *M. Cardenasii.*

1. **Mastigostyla Cabrerae** R. C. Foster in Contrib. Gray Herb. no. 171: 25 (1950). Bulb ovoid, about 2.5 cm. high and 1.5 cm. wide, the outer tunics thin, dark-brown. Stem for the most part subterranean, 3-7 cm. long, simple. Basal leaves mostly reduced to brown sheaths, rarely 1 produced, filiform, acute, to 10 cm. long and 0.5 mm. wide; cauline leaves 2, subtending the spathes, the lower one 12-22 cm. long, 2 mm. wide, linear, long-attenuate, acute, glabrous, the upper similar but shorter, to 6 cm. long. Spathes subequal or the outer longer, 2.5-3 cm. long, the outer one acuminate, obtuse, the inner one suboblong, broad at the apex, obtuse, 1-2-flowered. Ovary oblong-ellipsoid, glabrous, 7 mm. long. Flowers lilac-colored, obscurely spotted; outer tepals obovate-spatulate, to 2 cm. long and 5 mm. wide, long-unguiculate, rounded at the apex; inner tepals oblanceolate, 8 mm. long and about 1 mm. wide, the base of the claw glandular-tumescent. Stamen-column 8 mm. long; anthers linear, 4 mm. long. Style equal to the column in length; style-arms ca. 3 mm. long, bifid for about 1.5 mm., the style-crests much reduced, about 0.5 mm. long. Capsule and seeds not seen.

Known only from ARGENTINA. SALTA: San Antonio de los Cobres, Jan. 29, 1944, *A. L. Cabrera,* no. 8255 (type, GH).

The great reduction of the style-crests is a notable feature of this species. Other species with flowers of about the same size, *M. brevicaulis*, for instance, have very much longer style-crests.

2. **M. brevicaulis** (Baker) R. C. Foster in Contrib. Gray Herb. no. 161: 16 (1946). *Nemastylis brevicaulis* Baker, Handbk. Irid. 113 (1892). Bulb ovoid, to 2.5 cm. high, about 1 cm. in diameter, the tunics brown, membranous. Basal leaves 1-2, 20-30 cm. long, 3-4 mm. wide, linear, plicate, acute, glabrous; cauline leaves 1-2, 8-30 cm. long, 2-4 mm. wide, the uppermost usually subtending the spathes. Stem simple, to 20 cm. tall, terete, glabrous. Spathes herbaceous, subequal, to 3 cm. long, the outer acute, 1-3-flowered; pedicels filiform, not exserted at anthesis. Ovary ellipsoid-turbinate, to 5 mm. long, glabrous. Flowers blue; outer tepals long-unguiculate, oblanceolate, somewhat acute, to 1.8 cm. long and about 5 mm. wide; inner tepals 7 mm.

long, 0.75-1 mm. wide, glandular-tumescent at the base, linear or lance-linear, acute. Filament-column 6 mm. long; anthers 4 mm. long, deeply retuse at the apex. Style 7 mm. long; style-arms 2 mm. long, bifid for 1 mm. below the stigmas, the style-crests petaloid, rather than flagellar, 1 mm. long. Immature capsule turbinate, about 8 mm. long; seeds not seen.

Known only from BOLIVIA. La Paz: Larecaja: vic. Sorata; colle Ullontiji, 2700 m. alt., Jan.-Apr., 1859, *Mandon* 1224 in part (isotype, NY); Murillo: near La Paz, 3000 m. alt., Jan. 14, 1907, *Buchtien* no. 819 (US).

As explained when the transfer was originally made, the type-number contains a mixture of *Cypella* and *Mastigostyla*. The isotype at New York agrees well with the original description and, for that reason, the name has been limited to the *Mastigostyla* element.

3. **M. potosina,** spec. nov. Bulbus ovoideus, 2 cm. altus, 1 cm. latus, tunicae brunneae, tenues. Folia basalia 2 (in specimine incompleta), 2 mm. lata; folia caulina ad 10 cm. longa, 2 mm. lata, acuta, glabra. Caulis simplex, glaber, 3-6 cm. altus. Spathae subaequales vel exterior parum brevior, ad 3.5 cm. longae, acutae, herbaceae, 2-fl., pedicelli glabri, filiformes, anthesin non exserti. Ovarium oblongum, ad 6 mm. longum, glabrum. Flores caerulei, perianthii tubus ad 1 mm. longus; tepala exteriora longe unguiculata, obovata, 1.8 cm. longa et 6 mm. lata, apice truncato-obtusa, breve mucronulata; tepala interiora ovata, 5.5 mm. longa et 2.5 mm. lata, acute vel subacuta. Staminum columna circa 9 mm. longa; antherae 4.5-5 mm. longae, connectivus latus et pertenuis. Stylus columnam longitudine aequans; styli rami et cristae ad 1.4 cm longi, 2.5-3 mm. bifidi. Capsula seminaque ignota.

BOLIVIA: Potosí: between Potosí and Camargo, in sandy, rocky soil, 3800 m., Feb. 1949, *Cárdenas* no. 4265 (type, GH).

This species is most closely related to *M. brevicaulis* but can be readily distinguished by longer style-crests and shorter and broader inner tepals.

4. **M. Johnstonii** R. C. Foster in Contrib. Gray Herb. no. 155: 25 (1945). Bulb ovoid, 1-2.5 cm. high, 6-10 mm. in diameter, the tunics dark-brown, membranous. Basal leaves absent, or 1 rudimentary sheath at the base of the stem; cauline leaf borne on the stem about 4-8 cm. below the inflorescence, lance-linear, attenuate at base, acute, plicate, glabrous, at least 15 cm. long and 3-5 mm. wide. Stem simple, terete, glabrous, 10-20 cm. long. Spathes herbaceous, the outer 3.4-4.4 cm. long, acuminate, acute, the inner 3.2-4 cm. long, rather obtuse, retuse, 1-3-flowered, the pedicels 2.5-3.5 cm. long. Ovary ellipsoid, glabrous, to 8 mm. long. Flowers violet; outer tepals at least 1.8 cm. long and 6 mm. wide, long-unguiculate, obovate; inner tepals much reduced, 5-6 mm. long, about 2 mm. wide, ovate-oblanceolate, acute, the very short claw tumescent, apparently glandular. Stamen-column

6 mm. long; anthers nearly sessile on the column, 5 mm. long. Style as long as the column; style-arms and appendages 6 mm. long, the arms entire for 3 mm. and then bifid. Mature capsule and seeds not seen.

Known only from ARGENTINA. TUCUMÁN: CHICLIGASTA: Estancia Las Pavas, 3200 m. alt., Dec. 3, 1926, *Venturi*, no. 4636 (type, GH; isotype, US); Estancia Santa Rosa, 3600 m. alt., Dec. 13, 1925, *Venturi*, no. 6500 (US).

In habit, this species most closely resembles *M. brevicaulis*, but by the technical details of the flower it can readily be separated. The inner tepals are ovate to oblanceolate, rather than linear to lance-linear, and the style-arms and style-crests are much longer, with the crests more nearly flagelliform. From *M. brevicaulis* it differs further in that the spathes are not immediately subtended by cauline leaves.

5. **M. Hoppii** R. C. Foster in Contrib. Gray Herb. no. 155: 24 (1945). *Cypella Hoppii* Diels ex Macbride in Field Mus. Pub. Bot. **13**: 717 (1936), *nomen invalidum* (without Latin diagnosis). Bulb ovoid to subglobose, 1.5-2 cm. high, 1-1.5 cm. wide, the tunics dark-brown. Basal leaf solitary, shorter than the stem, 3.5-5 cm. long, mostly sheathing; cauline leaves 2, immediately subtending the inflorescence, the lower to 18 cm. long, spathiformly clasping at the base, the linear-attenuate blade acute, 1-2 mm. wide, the upper leaf similar, 2.5-7 cm. long, 1-1.5 mm. wide. Stem simple, terete, glabrous, 3-7 cm. tall. Spathes herbaceous, subventricose, the outer to 2 cm. long, acute, the inner to 2.5 cm. long, obtuse, 2-4-flowered, the pedicels shorter than the spathes, even in fruit. Ovary oblong, glabrous, about 5-6 mm. long. Flowers violet; outer tepals to 2.5 cm. long, the blade about 8-10 mm. wide, obovate, obtuse, unguiculate; inner tepals reduced, much smaller than the outer. Stamen-column to 1 cm. long, anthers 4-5 mm. long. Style as long as the column; style-arms and appendages about 7 mm. long. Capsule oblong-ellipsoid, rather sharply trigonous, about 1 cm. long; seeds dark-brown, angulate, 1.5-2 mm. long.

Known only from PERÚ. AREQUIPA: Arequipa, *Hopp* (type, Berlin, not seen; photo GH, F); open gravelly soil above Arequipa, 2500-2600 m. alt., Apr. 7-16, 1925, *Pennell*, no. 13173 (GH, NY); above Arequipa, 2500 m. alt., Apr. 7-16, 1925, *Pennell*, no. 13180 (F, PHIL).

No flowering material has been seen by me. The description given has been drawn up from the excellent photograph of the type and from fruiting material collected by Pennell.

6. **M. cyrtophylla** I. M. Johnst. in Contrib. Gray Herb. (n. s.) no. 81: 85 (1928). *Cypella cyrtophylla* (I. M. Johnst.) Diels in Engler & Prantl, Nat. Pflanzenfam. (ed. 2) **15a:** 498 (1930); Macbride in Field Mus. Pub. Bot. **13:** 716 (1936). Bulb ovoid, to 3 cm. high, 1.5-2 cm. wide, the membranous tunics dark-brown. Basal leaves 1-2, re-

duced to brownish sheaths, or if produced, to 30 cm. long, 1 mm. wide, linear, acute, glabrous; cauline leaves 1-2, to 30 cm. long, 2-4 mm. wide, exceeding the inflorescence, the uppermost reduced. Stem occasionally simple, but usually 1-2-branched well above the base, terete, glabrous, to 30 cm. long. Spathes herbaceous, drying with a purplish tinge, somewhat ventricose, subequal or the outer shorter, to 4 cm. long, several-flowered, the filiform pedicels not exserted at anthesis. Ovary oblong, glabrous, 4 mm. long. Flowers clear blue or violet, sometimes with darker spots; outer tepals long-unguiculate, the blades spreading, to 3 cm. long, 1.2 cm. wide, obovate, the apex obtuse; inner tepals more or less linear-oblanceolate, to 1.4 cm. long, 1.5 mm. wide, acute. Filaments entirely united, 8 mm. long; anthers to 6 mm. long. Style as long as or a little longer than the stamen-column; style-arms 5 mm. long, bifid for about 3 mm. below the stigmas, the flagelliform crests to 8 mm. long. Capsule and seeds not seen.

Known only from PERÚ. AREQUIPA: southern slopes of Chachani Mt., north of Arequipa, 2440-3660 m. alt., March, 1920, *Hinkley & Hinkley*, no. 16 (type, GH); open sandy soil above Arequipa, 2500-2600 m. alt., Apr. 7-16, 1925, *Pennell*, no. 13172 (GH, NY), and *Pennell*, no. 13173a (PHIL, F); alrededores de Arequipa, 2400-2500 m. alt., Mar. 31, 1949, *Vargas*, no. 8102 (GH); cerros de Tura, 2575-2620 m. alt., Mar. 28, 1949, *Vargas*, no. 7962 (GH); Yura, 2700 m. alt., Mar. 8, 1914, *Weberbauer*, no. 6838 (GH, F, US, NY).

Although the original description of this species gave details of capsule and seeds, these details were taken from *Pennell*, no. 13173, a specimen which I now consider to belong to *M. Hoppii*. The very long flagelliform style-crests of *M. cyrtophylla* represent the most extreme development of that structure in the genus.

7. **M. gracilis**, spec. nov. Bulbus ovoideus, 2.5 cm. altus, 1.5 cm. latus, tunicae atrobrunneae, membranaceae. Folia basalia 1-2, ad 50 cm. longa et 2-3 mm. lata, glabra, acuta, plicata; folia caulina 1-2, 4-14 cm. longa, 2 mm. lata. Caulis simplex vel 1-ramosus, teres, glaber, ad 26 cm. longus. Spathae subaequales, vel exterior parum brevior, ad 4 cm. longae, exterior acuminata, acuta, herbacea, interior apice obtusa et membranacea, 2-4-fl., pedicelli filiformes, glabri, anthesin non exserti. Flores caerulei, perianthii tubus ca. 1.5 mm. longus; tepala exteriora longe unguiculata, obovato-spathulata, subobtusa, ad 3 cm. longa et 8 mm. lata; tepala interiora oblanceolata, acuta, ad 10 mm. longa et 2 mm. lata. Staminum columna ad 1 cm. longa; antherae ad 6 mm. longae. Stylus columnam longitudine aequans; styli rami et cristae ad 9-10 mm. longae, rami 4 mm. bifidi. Capsula immatura oblongo-ovoidea, 1.3 cm. longa; semina non visa.

BOLIVIA: COCHABAMBA: MIZQUE: Chaguarani, in sandy red clay, 2700 m. alt., Mar. 31, 1939, *Eyerdam*, no. 25081 (type, UCAL; isotype, F).

Most closely related, probably, to *M. Joergensenii, M. gracilis* has a habit of growth which is much more open than that of its rather stiff congener. Its basal leaves are longer and wider, and the inner tepals longer than those of *M. Joergensenii.*

8. **M. Joergensenii** R. C. Foster in Contrib. Gray Herb. no. 171: 26 (1950). Bulb small, ovoid, to 2 cm. high, 9-10 mm. wide, the tunics brown, membranaceous. Basal leaves usually reduced, with 1 produced, to 28 cm. long and 1-2 mm. wide; cauline leaves 2, to 15 cm. long and 2 mm. wide, linear, acute, glabrous. Stem 1-2-branched well above the base, terete, glabrous, to 22 cm. long. Spathes herbaceous, subequal or the outer more or less shorter, to 4.8 cm. long, 3-4-flowered the filiform pedicels not exserted at anthesis. Ovary oblong-ellipsoid, to 5 mm. long, glabrous. Flowers blue or purple; outer tepals long-unguiculate, to 3 cm. long, the blade about 8 mm. wide, narrowly obovate or spatulate, obtuse; inner tepals to 7 mm. long, 2 mm. wide, oblanceolate, subacute, the base glandular-tumescent. Filaments almost entirely united, 1.2 cm. long; anthers linear, 8 mm. long. Style about 1.4 cm. long; style-arms 5 mm. long, bifid for 2 mm. below the stigmas; style-crests about 4 mm. long, subflagelliform. Capsule and seeds not seen.

Known only from ARGENTINA. CATAMARCA: Andalgalá [no further data available], *Jörgensen* (type, US no. 921640). LA RIOJA: Chilecito: Sierra de Famatina, camino a La Mejicana, 2550 m. alt., Feb. 5, 1927, *Parodi,* no. 8012 (GH).

In its size, this species suggests *M. Cardenasii,* but it is easily distinguished by its more or less flagelliform style-crests, narrower outer tepals, and by being branched well above the base.

9. **M. peruviana** R. C. Foster in Contrib. Gray Herb. no. 171: 25 (1950). Bulb ovoid, to 2 cm. high and 1.5 cm. wide, the thin smooth tunics dark-brown or blackish-brown. Basal leaves 1-2, 8-19 cm. long and 1-3 mm. wide, linear, acute, glabrous; cauline leaf 1, exceeding the inflorescence, 6-12 cm. long, to 2 mm. wide. Stem simple, terete, glabrous, 2-9 cm. long. Spathes subequal, 3 cm. long, not ventricose, 2-flowered; pedicels to 2.5 cm. long. Ovary obovoid, 8 mm. long, glabrous. Flowers blue; outer tepals about 2.2 cm. long, 6-7 mm. wide, long-unguiculate, the blade oblong, the apex obtusely rounded; inner tepals 8-9 mm. long, 2 mm. wide, narrowly elliptic, acute, the claw basally tumescent. Filaments united for 9 mm., free for 1 mm.; anthers 5 mm. long. Style 1 cm. long; style-arms 4 mm. long, bifid for 2 mm.; style-crests flagelliform, about 6 mm. long. Capsule and seeds not seen.

Known only from PERÚ. APURIMAC: ANDAHUAYLAS: quebrada 2 km. east of Andahuaylas, among grass, sand and clay, 3050 m. alt., Feb. 23, 1939, *Stork & Horton,* no. 10726 (type, F; isotype, UCAL).

Since *M. peruviana* is obviously caulescent and the single cauline leaf does not immediately subtend the spathes, it can readily and quickly be distinguished from the dwarf *M. Hoppii*. From *M. cyrtophylla* it is distinguished by its short unbranched stem, smaller flowers, and nonventricose spathes.

10. **M. Cardenasii** R. C. Foster in Contrib. Gray Herb. no. 155: 23 (1945); Foster in Contrib. Gray Herb. no. 161: 16 (1946). Bulb ovoid, 2-2.5 cm. high, 1.5 cm. in diameter, the dark-brown membranous tunics prolonged upwards in a collar around the base of the stem and leaves. Basal leaves 1-2, to 15 cm. long, 1.5 mm. wide, linear, acute, glabrous, finely ribbed; cauline leaf 1 (or none), the base spathiformly sheathing the stem, equaling or exceeding the inflorescence. Stem simple or branched near the base, 5-30 cm. long, terete, glabrous. Spathes herbaceous, firm-textured, to 4.5 cm. long, the outer with the margins basally united for 6-7 mm., acuminate, acute, the inner spathes equal to or longer than the outer, with broad hyaline margins, acute, 2-4-flowered; pedicels filiform, shorter than the spathes at anthesis. Ovary obovoid-ellipsoid, glabrous, about 8 mm. long. Flowers dark-blue, with darker spots; outer tepals long-unguiculate, obovate-spatulate, obtuse, to 3 cm. long and 1.5 cm. wide; inner tepals 5 mm. long, 1 mm. wide, narrowly elliptic-lanceolate, acute. Stamen-column to 1.2 cm. long, the filaments then free for 1-2 mm.; anthers linear, 6 mm. long. Style about as long as the stamen-column; style-arms and style-crests 1 cm. long, bifid for 5 mm., the stigmatic projections about 1.5 mm. long, the elliptic-lanceolate petaloid crests about 2 mm. long. Immature capsule ellipsoid-obovoid, to 1 cm. long; seeds not seen.

PERÚ: Cuzco: Saxaihuaman, 3400 m. alt., March, 1943, *Cárdenas*, no. 2337 (type, GH). BOLIVIA: Cochabamba: Tarata: Huayrapata, near Anzaldo, 3900 m. alt., in open sandy loam, April, 1944, *Cárdenas*, no. 2491 (US).

On the basis of present knowledge, the other species of this genus seem to be rather narrowly endemic. Consequently, it is of interest to find this species occurring in Perú near Cuzco and in the department of Cochabamba in Bolivia.

2. Cardenanthus R. C. Foster

Although much of the material seen was originally determined as *Nemastylis*, *Cardenanthus* differs from that genus, as well as from all but two other American bulbous genera, in having a definite perianth-tube. Usually short in itself, in relation to the size of the flowers, the tube is a rather marked element of the floral morphology. From *Eurynotia*

it differs not only in size but also in having divided style-arms, not simple style-arms as is true of that genus. From *Mastigostyla*, which it closely resembles in habit and vegetative characters, it differs in having the stigmatic area apical or lateral downward from the apex, not transverse at the base of style-crests. The general structure of the style and stamens associates the genus unmistakably with *Tigridia* and its allies.

Cardenanthus R. C. Foster in Contrib. Gray Herb. no. 155: 3 (1945) and no. 161: 13-15 (1946).

Plants small, bulbous, subacaulescent or appearing so. Leaves few, narrowly linear. Inflorescence subsessile, the spathes terminal, flowers shortly pedicellate. Flowers basally infundibuliform, perianth-tube present, short, the tepals very unequal in size and shape, the outer much larger. Stamens opposite the style-arms, the filaments united in a column inserted at the apex of the perianth-tube; anthers sessile or subsessile on the column. Style filiform, three-branched, the branches bifid, canaliculate, apically stigmatose. Capsule oblong-ellipsoid; seeds small, numerous.

Type-species: *C. boliviensis* R. C. Foster.

KEY

a. Inner tepals glandular-tumescent at base or apex of claw; perianth-tube over 3 mm. long
  b. Inner tepals 6 mm. long or less, 1 mm. wide, or less.
    c. Perianth-tube 4 mm. long.
      d. Inner tepals oblanceolate, 1 mm. wide; style-arms 2 mm. long, bifid for 1 mm. ..... 1. *C. orurensis.*
      d. Inner tepals linear, less than 0.5 mm. wide; style-arms 3.5 mm. long, bifid ca. 2 mm. ..... 2. *C. boliviensis.*
    c. Perianth-tube 7-8 mm. long ..... 3. C. *longitubus.*
  b. Inner tepals more than 6 mm. long, the narrowly linear or oblanceolate blade 1.5 mm. wide.
    e. Staminal column ca. 1 cm. long; outer tepals 8 mm. wide. ..... 4. *C. peruvianus.*
    e. Staminal column ca. 7 mm. long; outer tepals ca. 4 mm. wide. ..... 5. *C. Shepardae.*
a. Inner tepals not glandular-tumescent; perianth-tube not over 2 mm. long.
  f. Inner tepals to 3.5 mm. long, widest at the base. ..... 6. *C. tunariensis.*
  f. Inner tepals to 8 mm. long, widest above the middle.
    g. Inner tepals narrowly oblanceolate, 1 mm. wide. 7. *C. Venturii.*
    g. Inner tepals obovate-spatulate, 3 mm. wide. ..... 8. *C. Vargasii.*

1. **Cardenanthus orurensis** R. C. Foster in Contrib. Gray Herb. no. 161: 14 (1946). Plant nearly acaulescent, the bulb ovoid, 2-2.5 cm.

high, 1-2 cm. wide, the tunics brown or blackish-brown, rather thin. Basal leaves 1-2, much reduced, 2-4 cm. long, little more than fuscous or straw-colored sheaths, rarely 1 produced basal leaf present, to 12 cm. long, 1 mm. wide; cauline leaves 2, subtending the spathes, the lower one 13-15 cm. long, 1.5-2 mm. wide, linear, acute, several-nerved, glabrous, the upper leaf similar, 3.5-5 cm. long, 1 mm. wide. Outer spathe to 2 cm. long, herbaceous or submembranaceous, acute, the inner spathe to 2.4 cm. long, apically truncate, 1- (rarely 2-) flowered; pedicels to 6 mm. long. Ovary oblong, glabrous, 5-7 mm. long. Flowers blue or blue-purple; perianth-tube 4 mm. long; outer tepals to 1.2 cm. long and 6 mm. wide, shortly unguiculate, obovate, apically somewhat obtuse; inner tepals to 4-4.5 mm. long, 1 mm. wide, narrowly elliptic or oblanceolate, acute, the base of the claw glandular-tumescent. Staminal column 5 mm. long; anthers linear, 3 mm. long. Style as long as the column; style-arms 2 mm. long, bifid for 1 mm. Capsule and seeds not seen.

Known only from BOLIVIA. Oruro: Cercado: Hacienda Huancaroma, near Eucaliptus, 3000 m. alt., Feb. 19-27, 1934, *Hammarlund*, no. 94 (type, NY).

A second specimen, in fruit, from which the details of capsule and seeds have been drawn for the generic characterization, may belong here or with the next species. It is *Asplund*, no. 6362 (US), from Uyuni, in the Department of Potosí, collected at 3700 m. alt., Mar. 25, 1921.

2. **C. boliviensis** R. C. Foster in Contrib. Gray Herb. no. 155: 4 (1945) and no. 161: 14 (1946). Plant seemingly acaulescent, but with a 2-4 cm. underground stem, the bulb ovoid, 2 cm. high, 1 cm. wide. Basal leaves absent; cauline leaves 2, immediately subtending the spathes, the lower to 9 cm. long, 1 mm. wide, the upper to 4 cm. long, 1 mm. wide, linear, acute, glabrous. Spathes herbaceous, the outer 1.5-2 cm. long, the inner 2-2.5 cm. long, obtuse, retuse, 2-3-flowered, the flowers subsessile. Ovary ellipsoid, glabrous, about 3 mm. long. Flowers blue; perianth-tube to 4 mm. long; outer tepals to 1.4 cm. long, 4-5 mm. wide, ovate, acuminate to the subobtuse apex; inner tepals to 5 mm. long, linear, the base of the claw glandular-tumescent, the enlarged portion to 0.75 mm. long, the blade about 0.33 mm. wide, not acuminate, blunt at the apex. Staminal column 5 mm. long; anthers 5 mm. long. Style about 8-9 mm. long; style-arms 3.5 mm. long, bifid for more than half their length, the stigmatic area ciliate. Capsule and seeds unknown.

Known only from BOLIVIA. Potosí: Potosí, 4000 m. alt., Jan. 1932, *Cárdenas*, no. 124 (type, GH).

Unlike other members of the genus, in this species the blade of the inner tepals seems to be completely linear, with a blunt apex.

3. **C. longitubus** R. C. Foster in Contrib. Gray Herb. no. 171: 23

(1950). Bulb ovoid, to 1.5 cm. high, 1 cm. wide, the thin tunics dark-brown. Leaves basal, several, the outermost reduced to ventricose cataphylls, the inner 3-4 long-sheathing, the narrowly linear, strongly recurved, glabrous, acute blades to 10 cm. long, 1 mm. wide (or less), the midrib and edges thickened. Stem mainly subterranean, simple, terete, glabrous, to 3 cm. long. Spathes equal or unequal, the outer to 2.2 cm. long, abruptly acuminate, the inner nearly as long, or somewhat shorter, obtuse, 1-2-flowered, pedicel filiform, glabrous, to 6 mm. long. Ovary narrowly ellipsoid, 6 mm. long, glabrous, trigonous. Flowers light purple, sometimes with darker streaks; perianth-tube to 7-8 mm. long, narrowly cylindrical, abruptly ampliate at the apex; outer tepals long-clawed, obovate, to 1.5 cm. long, the somewhat acute blade to 6 mm. wide; inner tepals linear, acute, to 6 mm. long, slightly less than 1 mm. wide, with a tumescent patch about 1.5 mm. above the base. Staminal column 5 mm. long; anthers linear, 4-5 mm. long. Style 1.4 cm. long; style-arms 1 mm. long, bifid for 0.5 mm. Mature capsule and seeds not seen.

Known only from BOLIVIA. La Paz: Pacajes: Rosario, 4100 m. alt., Jan. 13, 1921, *Mrs. R. B. Shepard*, no. 235 (type, GH; isotype, US).

Growing in wet sandy soil, this species can be distinguished from its congeners by the longest perianth-tube and the longest style in the genus.

4. **C. peruvianus** R. C. Foster in Contrib. Gray Herb. no. 171: 24 (1950). Bulb ovoid, to 2 cm. high, 1.5 cm. wide, the thin tunics dark-brown. Basal leaves 1-2, to 28 cm. long and 0.5-1.5 mm. wide, plicate, glabrous, very acute; cauline leaves 1-2, to 25 cm. long, 1.75 mm. wide, immediately subtending the spathes. Stem simple, mostly subterranean, 2.5-4 cm. long. Spathes about equal, or the outer somewhat longer, to 3 cm. long, obtuse, 1-2-flowered, the glabrous pedicels to 7 mm. long. Ovary truncately ellipsoid, glabrous, to 7 mm. long. Flowers pale violet with darker spots; perianth-tube 4 mm. long; outer tepals to 1.8 cm. long, 8 mm. wide, obovate-spatulate, somewhat obtuse; inner tepals to 8 mm. long, 1.5 mm. wide, oblanceolate, acute, the claw short and glandular-tumescent. Staminal column to 10 mm. long; anthers 3-3.5 mm. long. Style to 1.1 cm. long; style-arms 2.5 mm. long, bifid for 1.5 mm., wide, conduplicate. Capsule and seeds unknown.

Known only from PERÚ. Tacna: Tarata: Candarave, 2900-3000 m. alt., Mar. 11-13, 1925, *Weberbauer*, no. 7387 (type, F).

Growing in open shrubbery, this close relative of *C. Shepardae* can be distinguished from it by the longer style, longer staminal column, less bifid style-arms, and broader outer tepals.

5. **C. Shepardae** R. C. Foster in Contrib. Gray Herb. no. 155: 5 (1945). Bulb ovoid, 1.5 cm. high, 0.5-1 cm. wide. Basal leaves 1-2, to 4 cm. long, 1 mm. wide, glabrous; cauline leaf single, subtending

the spathes, itself somewhat spathiform, to 2.7 cm. long, 1 mm. wide, subfalcate. Stem mostly underground, 1-1.5 cm. long. Spathes herbaceous, the outer to 2.2 cm. long, acuminate, acute, the inner to 2.5 cm. long, tapering to a blunt retuse apex, 2-flowered, the pedicels about 4 mm. long at anthesis. Ovary about 5 mm. long, ellipsoid, glabrous. Flowers light purple; perianth-tube to 4 mm. long; outer tepals ca. 1.5 cm. long, ca. 4 mm. wide, oblanceolate-spatulate; inner tepals ca. 1 cm. long,1.5 mm. wide, linear or narrowly oblanceolate, with an oval glandular patch on the claw 4 mm. above the base. Staminal column ca. 7 mm. long; anthers 4 mm. long. Style as long as the column; style-arms 2.3-4 mm. long, bifid nearly to the base. Capsule and seeds unknown.

Known only from eastern PERÚ. PUNO: HUANCANÉ: Umuchi, in sandy places, 3125 m. alt., Dec. 10, 1919, *Mrs. R. S. Shepard,* no. 99 (type, GH).

Through an unfortunate error, presumably in typing the manuscript, the original description stated that the length of the staminal column was 1.1 cm.; this has been corrected in the description given above.

6. **C. tunariensis** R. C. Foster in Contrib. Gray Herb. no. 155: 5 (1945) and in no. 161: 15 (1946). *Nemastylis nana* sensu Rusby, non S. Watson, in Mem. Torr. Bot. Club, **6**(1): 125 (1896), in part. Plant subacaulescent, the ovoid bulb to 2 cm. high, about 1 cm. wide. Basal leaf solitary, 7-12 cm. long, 1 mm. wide; cauline leaf solitary, subtending the spathes, 4-8 cm. long, 1 mm. wide, acute, glabrous. Spathes herbaceous, the outer to 3 cm. long, acute, acuminate, the inner 1.7-2.6 cm. long, subobtuse, 2-flowered, the pedicels to 1.3 cm. long. Ovary ellipsoid, glabrous, 4 mm. long. Flowers blue or purple; perianth-tube to 2 mm. long; outer tepals 1 cm. long, the blade 4 mm. wide, oblanceolate; inner tepals to 3.5 mm. long, 1 mm. wide at the base, narrowly lance-deltoid, acuminate, acute, eglandular. Staminal column 5 mm. long; anthers 3-3.5 mm. long, nearly sessile on the column. Style as long as the column; style-arms 1.5 mm. long, bifid almost to the base. Capsule and seeds unknown.

Known only from BOLIVIA. COCHABAMBA: CERCADO: near snow-line, Mt. Tunari, 1891, *Bang*, no. 1042 (type, GH; co-types US, MBG).

Although the available material of this species is scanty and poor, it seems established that the inner tepals lack the glandular-tumescent area and are broadest at the base.

7. **C. Venturii** R. C. Foster in Contrib. Gray Herb. no. 155: 6 (1945). Bulb ovoid, 1.5-2 cm. high, 1-1.5 cm. wide. Basal leaves 1-2, to 10 cm. long, 1 mm. wide, acute, glabrous; cauline leaf solitary, subtending the spathes, to 6.5 cm. long, 1 mm. wide. Stem mostly underground, 1-2 cm. long. Spathes herbaceous, to 2.5 cm. long, subequal or the inner somewhat shorter, the outer acute, the inner obtuse, 2-flowered, the pedicels to 5 mm. long at anthesis. Ovary ellipsoid, glabrous, about

4 mm. long. Flowers blue; perianth-tube 2 mm. long; outer tepals to 1.5 cm. long, 3 mm. wide, oblanceolate-spatulate, subobtuse; inner tepals 8 mm. long, 1 mm. wide, narrowly oblanceolate, acute, not glandular-tumescent. Staminal column 7 mm. long; anthers sessile on the column, 2.5 mm. long. Style as long as the column; style-arms 1.5 mm. long, bifid for 0.5 mm. Capsule and seeds unknown.

Known only from northern ARGENTINA. JUJUY: HUMAHUACA: Cerro La Soledad, 3500 m. alt., Jan. 25, 1928, *Venturi*, no. 9025 (type, GH; isotype, US). TUCUMÁN: CHICLIGASTA: Estancia Santa Rosa, 4600 m. alt., Dec. 13, 1925, *Venturi, no.* 4065 (US).

Since the original publication of this species, another collection has been seen, which strengthens my feeling of its distinctness.

8. **C. Vargasii** R. C. Foster in Contrib. Gray Herb. no. 171: 24 (1950). Bulb small, more or less globose, about 1 cm. in diameter, the brown, thin membranous coats prolonged upward in a collar. Basal leaves several, basally long-sheathing, the sheaths reaching nearly to the middle of the spathes, the blades sharply reflexed outward above the sheaths, to 6 cm. long, 2 mm. wide, plicate, lance-linear, acute, glabrous. Stem mostly subterranean, simple, to 1.5 cm. long, cauline leaves apparently absent. Spathes subequal, to 1.8 cm. long, acute, or the inner subobtuse, 1- (rarely 2-) flowered, the flowers shortly pedicellate, the pedicels only a few mm. long. Ovary oblong-ellipsoid, glabrous, to 5 mm. long. Flowers white, with violet lines; perianth-tube to 1.5-2 mm. long; outer tepals spatulate, to 1.2 cm. long, the obtuse, retuse blade 6 mm. wide, the apical indentation crenulate; inner tepals unguiculate, the claw 2 mm. long, not glandular-tumescent, the obovate-spatulate blade 6 mm. long, 3 mm. wide, obtuse. Filaments completely united, the tube 4 mm. long; anthers 2.3 mm. long. Style 6 mm. long; style-arms 1.5 mm. long, bifid almost to the base, broad, conduplicate, with an internal central ridge and a minute tubercle at each secondary sinus. Capsule and seeds not seen.

Known only from PERÚ. PUNO: CARABAYA; pampa de Lacka, Macusani, 4360 m. alt., Feb. 15, 1948, *Vargas* (*leg. E. P.*), no. 7135 (type, GH).

The broad inner tepals and the lack of cauline leaves serve to distinguish this species from its relatives. The most noteworthy difference, aside from the color of the flower, is the presence of small tubercles at the secondary sinuses of the style-arms. These have not been noted in other members of the genus.

3. ANOMALOSTYLUS R. C. FOSTER

Until recently, the species treated here as belonging to *Anomalostylus* have been considered to belong to *Cypella*.

The principal difference between the two genera is the strange development of the style in *Anomalostylus*. Not only are the style-arms suppressed, as is rarely true in *Cypella*, but the style-crests are fused in such a manner that three apical lobes, alternate with the stamens, are produced. Actually, however, the stamens are opposite the transverse stigmatic areas, so that there can be no question of the relationship of *Anomalostylus* and *Cypella*.

Anomalostylus R. C. Foster in Contrib. Gray Herb. no. 165: 110 (1947).

Bulbous, perennial, caulescent herbs, the bulbs probably rather large. Basal leaves several, cauline leaves few. Inflorescences terminal on the main axis and branches, the flowers long-pedicellate in herbaceous spathes. Flowers crateriform, the tepals basally connate, but a perianth-tube absent, the two series of tepals dissimilar in size and shape. Filaments free or slightly united at the base; anthers apically and adaxially adherent to the style-wings below the stigmatic areas. Style long-cyathiform, strongly trialate, style-arms completely obsolete, the three sides of the style produced above the stigmas as low, semi-orbicular, or truncately deltoid, retuse lobes, these alternate with the stamens; stigmatic tongues two above each stamen, transverse, small, falcate, fimbriate-papillate, the stigmatic area apparently continued along the inner edge of each lobe to the retuse apex. Capsule and seeds unknown.

Type-species: *A. crateriformis* R. C. Foster.

KEY

a. Leaves and spathes densely pruinose. ..... 1. *A. grandis.*

a. Leaves and spathes not pruinose.

b. Basal leaves to 80 cm. long and 1.8 cm. wide; pedicels shorter than inner spathe at anthesis; filaments 5-6 mm. long. ..... 2. *A. crateriformis.*

b. Basal leaves to 40 cm. long and 4-5 mm. wide; pedicels equaling the inner spathe at anthesis; filaments 3-4 mm. long ..... 3. *A. coriifolius*

1. **Anomalostylus grandis** (Kränzl.), comb. nov. *Cypella grandis* Kränzl. in Fedde, Rep. Spec. Nov. **14:** 295 (1916). Bulb large, ovoid, 7-8 cm. high and 4 cm. wide, the tunics verrucose (*fide* Kränzlin). Basal leaves about 4, linear-attenuate, acute, stiff, with numerous fine veins, pruinose, to 60 cm. (80 cm. *fide* Kränzlin) long, to 1.8 cm. wide; cauline leaves 3-4, appressed against the stem, overlapping or subimbricate, pruinose, acute, thick, very firm-textured, the lowest to 20 cm. long (45 cm. *fide* Kränzlin), two-thirds sheathing, the upper leaves reduced to more or less sheathing, spathiform, carinate bracts. Stem terete, glabrous, branched, nearly 70 cm. tall. Spathes pruinose, nearly equal, the outer a few millimeters shorter

than the inner, to 6 cm. long (8 cm. *fide* Kränzlin), broad, rather abruptly acute, carinate, rigid, finely veined, the inner similar but truncate at the somewhat membranous apex, 2-3-flowered; pedicels stoutish, glabrous, well-exserted from the spathes at anthesis. Ovary oblong-clavate, to 2 cm. long, glabrous. Flowers yellow (*fide* Kränzlin); outer tepals oblong-obovate, without marked differentiation between blade and claw, the inner face of the lower portion rather sparsely glandular-pubescent, about 4 cm. long and 1.8 cm. wide (6 cm. x 2.5 cm., *fide* Kränzlin), the rather blunt apex somewhat penicillate; inner tepals about 2 cm. long and 1 cm. wide (3 cm. x 8 mm., *fide* Kränzlin), with a well-marked, long, spatulate-naviculate claw, the margins more or less densely glandular-cilate, somewhat erect or spreading, but inflexed and with a broad pubescent arc at that point, the oblong-ovate blade strongly deflexed, not glandular-ciliate, with a broad pubescent patch in the center. Filaments very slightly united at the base, 4 mm. long; anthers linear, 8-9 mm. long, adnate to the style about 2 mm. below the sinuses. Style 1.5 cm. long, filiform for about 4 mm., then dilating and becoming oblong-cyathiform upward, the three apical lobes rounded, about 5 mm. broad at the base and 2 mm. high.

Known only from PARAGUAY. Sierra de Amambay, January, *Hassler* (*coll. Rojas*) no. 10,001 (type, not seen; photo, GH, F); in the neighborhood of the Río Alto Paraná, 1909/10, *Fiebrig*, no. 6273 (GH, US); Cordillera de Altos, Oct. 8, 1902, *Fiebrig*, no. 224 (F).

This stiff erect plant with firm-textured leaves is easily distinguished from the other two species by the heavily glaucous or pruinose leaves and spathes, by the sheathing cauline leaves, which conceal most of the upper portion of the stem, and by the very thick texture of the flowers.

2. **A. crateriformis** R. C. Foster in Contrib. Gray Herb. no. 165: 111 (1947). Bulb incompletely known, probably large. Basal leaves several, to 80 cm. long and 1.8 cm. wide, linear, acute, glabrous, not pruinose, striate with numerous fine veins, the central vein distinctly more prominent than the rest; cauline leaves 2-4, the lowermost 12-42 cm. long, basally sheathing, the upper ones successively reduced, but not concealing the stem. Stem 1-3-branched, terete, glabrous. Spathes herbaceous, rather naviculate, the outer striate, carinate, abruptly acute, 3.5-4.5 cm. long, the inner slightly longer, truncate, several-flowered; pedicels shorter than the inner spathe at anthesis, rather slender, glabrous, ultimately elongating. Flowers apparently yellow; outer tepals obovate, to 3.5 cm. long and 2.2 cm. wide, without well-marked differentiation between blade and claw, the basal portion with 8-9 ridges and very sparse puberulence on the inner surface, the apex of the blade retuse with a short, blunt, penicillate apiculus; inner tepals to 2.5 cm. long and 1 cm. wide, the spatulate-naviculate claw flushed and streaked with blue or purple, much darker than the outer tepals (at least in dried material), densely glandular-ciliate,

the inner face glandular-pubescent, erect or somewhat spreading, somewhat inflexed at the apex, the strongly reflexed blade yellow, with a broad U-shaped pubescent patch and 2 round or oval pubescent patches in the center, these sometimes confluent, the apex rather blunt and penicillate. Filaments united at the base for 1 mm., 5-6 mm. long; anthers 7-11 mm. long, adherent to the style 1-2 mm. below the sinuses. Style enlarged upward almost from the base, 1.4-1.5 cm. long, the low, rounded or subdeltoid, apical lobes 3-4 mm. wide at the base and 1.5 mm. high.

BRAZIL: PARANÁ: Serrinha, ad marg. viae ferreae, Oct. 14, 1909, *Dusén*, no. 8705 (type, US; isotype, NY); MINAS GERAIS: 1865-66, *Regnell*, III, no. 1214 (US); Arceira, Feb. 24, 1951, *A. Macedo*, no. 3212 (US); RIO GRANDE DO SUL: Estancia L. Gomez (Neu-Württemberg), 500 m. alt., Oct. 18, 1904, *Bornmüller*, no. 302 (GH). PARAGUAY: in the campo Estancia Primera, January, 1932, *Jörgensen*, no. 4537 in part (as to NY, PHIL).

As was pointed out in the original description, this plant is almost certainly the one figured by Larrañaga, Escritos, Atlas, 1: t. XII (1927). It has been sufficiently distinguished from *A. grandis*, and from *A. coriifolius* it may be separated by its larger size, thicker leaves, pedicels shorter than the spathes at anthesis, longer filaments, and by the much thicker texture of the tepals and style.

3. **A. coriifolius** (Baker), comb. nov. *Cypella coriifolia* Baker in Bull. Herb. Boiss. (ser. 2) **3:** 1103 (1903). Bulb incompletely known but apparently large. Basal leaves several, to 40 cm. long, 4-5 mm. wide, linear, acute, glabrous, not pruinose, rather thick and rigid, densely and finely nerved, the mid-nerves hardly more prominent than the rest; cauline leaves 2-3, the lower-most partly sheathing, 7-20 cm. long, 3-7 mm. wide, the upper ones mostly sheathing, spathiform, but not concealing the upper portion of the stem. Stem 2-3-branched, terete, glabrous, to 66 cm. tall. Spathes herbaceous, finely veined, rather stiff, unequal, the outer to 4 cm. long, long-acute, the inner somewhat longer, truncate at the apex, several-flowered; pedicels slender, equaling the inner spathe at anthesis, glabrous. Ovary oblong-ellipsoid, to 7 mm. long, glabrous. Flower pale yellow, tinged or spotted with blue at the base within; outer tepals not well-differentiated into claw and blade, obovate-spatulate, the apex retuse with a very short penicillate mucro, to 3.2 cm. long and 1.5 cm. wide, the basal portion sparsely glandular-puberulent and about 8-ridged on the inner face; inner tepals somewhat shorter, the margin, except the upper half of the blade, glandular-ciliate, the claw narrow at the base, then widening considerably, becoming spatulate-naviculate, the inner face with about 5 ridges and sparsely puberulent, erect or somewhat spreading but inflexed at the apex, with a dense, broadly U-shaped, pubescent blotch at the base of the strongly reflexed,

broadly ovate (8-9 mm. wide) blade, with a semi-lunate patch in the center of the blade, the apex rather blunt and shortly penicillate. Filaments slightly united at the base, 3-4 mm. long; anthers 6-7 mm. long, adnate to the style about 2 mm. below the sinuses. Style 1.2 cm. long, filiform at the base but soon becoming cyathiform, the 3 apical lobes semiorbicular or truncately deltoid, about 2.5 mm. wide at the base and 1.5 mm. high.

Known only from PARAGUAY. In the campo Hiatý, January, 1930, *Jörgensen*, no. 4532 (US, NY, MBG, F, PHIL); in the campo Tapytú, March, 1931, *Jörgensen*, no. 4537 in part (as to US, MBG).

This species is admittedly close to the preceding, but seems distinct. To the points of differentiation mentioned in the discussion of *A. crateriformis*, the increased glandular-ciliation of the inner tepals of *A. coriifolius* may be added.

4. Notes on Trimezia

For a number of years, the binomial *Tritonia riparia* Cordemoy, Fl. Île Réunion, 161 (1895), has seemed to me to be a "spook." It seemed highly unlikely that a true *Tritonia* should be found native on the island of Réunion. Dr. E. P. Phillips, Gen. S. Afr. Fl. Pls. (ed. 2) 218 (1951), says of the generic distribution: "between 40 and 50 species in South Africa, found mostly in the southwestern districts of the Cape Province, but extending from Namaqualand through the coastal area into Natal; found also in the Transvaal." But that is a far cry from Réunion. There is in the Gray Herbarium a sheet from Réunion, collected by G. de L'Isle, no. 562, from one of the localities cited in the original publication of the species, "Ravine sèche, St. Benoit." The plant seemed strangely familiar in appearance and dissection soon showed that it is the widespread and common Caribbean irid, *Trimezia martinicensis* (Jacq.) Herb. As a result, the binomial *Tritonia riparia* becomes an additional synonym of *Trimezia martinicensis*, a name already well-burdened with synonyms.

Within the past few years I have had more than one inquiry as to the correct spelling of the generic name *Trimezia*, my correspondents pointing out that the original spelling was *Trimeza*. This is correct. The generic name was spelled *Trimeza* when it was published by Salisbury in

Trans. Hort. Soc. 1: 308 (1812). However, this name was published as a *nomen nudum* and must, therefore, be disregarded. The first valid use of the name known to me is Herbert's in Bot. Reg. 30: Misc. p. 88 (1844), where he used the spelling *Trimezia*. Since Herbert gave a generic character, there can be no question of the validity and legitimacy of the publication. Therefore, Herbert's spelling, *Trimezia*, rather than Salisbury's spelling, *Trimeza*, must be used.

Again in response to inquiry, it should be noted that the binomial *Trimezia martinicensis* (Jack.) Herb. was made in the description of *T. meridensis* Herb. in Bot. Reg. 30: Misc. p. 88 (1844), where Herbert wrote "Caetera ut in T. Martinicensi." In the brief English discussion which followed, he referred to "This plant, handsomer than the old species, long called Iris Martinicensis. . . ." Consequently, there can be no doubt concerning the basionym of *T. martinicensis*. Since the two binomials, *T. martinicensis* and *T. meridensis*, were thus published simultaneously, as well as simultaneously with the validation of the generic name, it becomes necessary to select one of them as the type-species of the genus. Since *T. martinicensis* is based on the much older and well-understood name of Jacquin, I am designating it as the type-species. The second species, *T. meridensis*, is not well-understood (indeed, there is considerable question as to what it is, as well as to whether it represents merely a local variant of *T. martinicensis* or is a distinct species), and it seems to me ill-advised to select a doubtful concept as the type of the genus.

Trimezia lutea (Klatt), comb. nov. *Cypella lutea* Klatt in Mart. Fl. Bras. **3**(1): 522 (1871). *Marica bulbosa* Klatt in Abh. Naturf. Ges. Halle, **16**: 374 (1882). *Neomarica bulbosa* (Klatt) Sprague in Kew Bull. **1928**: 281 (1928).

It is obvious from an excellent photograph of *Martius*, no. 437, from Minas Gerais, Brazil, which may be chosen as the lectotype, that *Cypella lutea* Klatt is unquestionably a *Trimezia*. It differs from *T. martinicensis* in having the single cauline leaf close to the apex of the stem, with the inflorescence appearing pseudolateral in some instances. The rootstock, however, is completely characteristic of *Trimezia*,

resembling a small bulb or corm, with the outer tunics split into parallel fibers. No other genus of New World irids possesses such a rootstock, and for that reason *Cypella lutea* Klatt is here transferred to *Trimezia*. The name *Marica bulbosa* was merely a renaming by Klatt when he transferred the plant to *Marica*, because of the existence of *Marica lutea* Herb. But Herbert's name was apparently a *nomen provisorium* and must be disregarded. In any case, it could not bar the use of the epithet *lutea* in *Trimezia*.

BRAZIL: MINAS GERAIS: Ouro Preto, *Martius*, no. 437 (lectotype; photo GH). COLOMBIA: META: Rancho Menegua, 100 km. SE of Villavicencio, *Helen Schieffer*, no. 816 (GH).

Trimezia Martii (Baker), comb. nov. *Marica Martii* Baker, Handbk. Irid. 63 (1892). *Neomarica Martii* (Baker) Sprague in Kew Bull. 1928: 281 (1928).

From the description of the rootstock, it seems clear that *Marica Martii* is a *Trimezia*. Since it seems distinct from other species of the *martinicensis*-complex, I am retaining it as a separate species, at least for the present.

Trimezia fistulosa, spec. nov. Perennis, breve rhizomatosa, rhizoma ad 3-4 cm. crassum, foliis vetustioribus vestitum, haec deinde in fibris parallelibus. Folia basalia plura, perfistulosa et tubulosa, perrecurvata, ad 20 cm. longa et 6-8 mm. in diametro, glabra. Scapus ad 15 cm. altus, glaber, folia caulina absentia. Spathae plures, terminales, spatha infima ad 2 cm. longa, acuta, spatha suprema ad 3.5 cm. longa, obtusa, apice hyalina et subcrenulata. Pedicelli 3-4, spathas anthesin aequantes. Ovarium glabrum, oblongum, ad 8 mm. longum. Flores fructus seminaque ignota. BRAZIL: MINAS GERAIS: Serra do Cipó, 1800 m., Aug. 5, 1936, *W. A. Archer*, no. 3675 (type in U. S. Nat. Herb.; isotype in herb. U. S. Nat. Arb.); Serra do Cipó, Santa Luzia, km. 118, Aug. 23, 1933, *Mello Barreto*, no. 3040 (F); Diamantina, *Glaziou* (photo, GH).

To describe a new irid without flowers, fruit or seeds may appear somewhat rash. Yet the rootstock is that of a *Trimezia* (in the *Lansburgia* group), and the leaves are unique in American irids. Thick, firm-textured, strongly recurved and tubular-fistulose, they leave no alternative to describing the plant as a new species. According to a handwritten note on the Glaziou specimen, the flowers are yellow, which accords with the attribution to *Trimezia*. When flowers are available for study, it is possible that this plant may prove

to represent an undescribed genus. For the time being, however, I prefer to leave it in *Trimezia*.

Trimezia Steyermarkii, spec. nov. A *T. martinicensi* foliis longis et latis, caule ramoso, et rhizomate crasso magnoque differt. Rhizome to 4 cm. wide and 4 cm. long. Leaves ensiform, thin-textured, the midrib prominent, to 60 cm. long and 2 cm. wide, occasionally a little wider. Spathes obviously terminal and not pseudolateral, several-flowered, herbaceous, thin-textured, unequal, the outer spathe about 2 cm. long, the inner to 3 cm. long, or a little longer. Pedicels glabrous, equaling the spathes at anthesis. Ovary glabrous, more or less clavate, less than 1 cm. long. Flowers yellow with purple or brown-purple bands, probably not over 3 cm. in diameter. Style and stamens those of *Trimezia*. Fruit and seeds unknown. GUATEMALA: ALTA VERAPAZ: Pansamala, 4100 ft., *J. D. Smith, Pl. Guat.* no. 1786 (US); along Quiché highway about 12 km. west of San Cristóbal, 1100 m., in dense mixed forest, *Standley*, no. 89752 (F, GH); wooded slope near Río Icvolay, near Hacienda Yaxcabnal, 5 mi. NW. of Cubilgüitz, 250-300 m., *Steyermark*, no. 44690 (F, GH); between Hacienda Yaxcabnal alonga Río Icvolay and Río Apia, 6-8 mi. NW of Cubilgüitz, 210-250 m., *Steyermark*, no. 45011 (F, GH); vicinity of Río Dolores, near Dolores, 1-2 mi. NE. of Cubilgüitz, 290-300 m., *Steyermark*, no. 44827 (F, GH); Coban, 1500 m., *von Tuerckheim* in *J. D. Smith, Pl. Guat.* no. 96 (US); Coban, 1400 m., *von Tuerckheim* II, no. 760 (US); *von Tuerckheim* (US no. 933767); Huehuetenango: cafetal of Finca Soledad, 5 mi. SE. of Barillas, Sierra de los Cuchumatanes, 1150 m., *Steyermark*, no. 49539 (type, GH; isotype, F).

No satisfactory material is available at the moment for dissection, and so floral details cannot be given. Bud-dissection shows, however, that the plant is a *Trimezia*. Most of the material cited was originally determined as *Neomarica*.

In addition to the Guatemalan material cited, there are two additional collections from southern Mexico which probably belong here.

OAXACA: Lalana, 1000 m., Chinantla, Teotalcingo, *Galeotti* no. 5380 (US). CHIAPAS: Chicharras, 1000-2000 m., *E. W. Nelson*, no. 3756 (US).

5. MISCELLANEOUS NOTES AND NOVELTIES

In the treatment of the family *Iridaceae* in Macbride's Flora of Peru (Field Mus. Pub. Bot. **13**(1) : 707-717 [1936]), the genus *Eleutherine* is not included. Consequently, it was a matter of great interest to discover a sheet of *Eleutherine bulbosa* (Mill.) Urban in a small but important suite of

specimens sent to the Gray Herbarium by Dr. César Vargas C. The data for the specimen are as follows: PERÚ: CUZCO: CONVENCIÓN: Quillabamba, Granja de Misiones, 1040 m. alt., enero-marzo, 1947, *Vargas*, no. 6347.

Through the kindness of Dr. Vargas, an isotype of *Cypella Goodspeediana* Vargas (*Vargas*, no. 2509) has been presented to the Gray Herbarium. Its appearance is not typical of *Cypella* and a bud-dissection showed unmistakably that it is a *Cipura*. The following transfer is thus necessary.

Cipura Goodspeediana (Vargas), comb. nov. *Cypella Goodspeediana* Vargas in Revist. Univ. Cuzco, **33** (no. 87): 171 (1945).

During determinative work, over a period of years, three apparently undescribed species of *Sisyrinchium* have been noted. Their descriptions follow.

Sisyrinchium bromelioides, spec. nov. Herba perennis, rhizomatosa, rhizoma subcrassum, breve. Folia basalia ad 110 cm. longa et 2 cm. lata, minute denseque papillosa, marginibus tenuibus; folia caulina nulla. Caulis ad 60 cm. altus (ad 2 m. *fide* Rambo), ancipitus, bractea terminalis ad 8-9 cm. longa. Inflorescentia terminalis non pseudolateralis, ad 30 cm. alta, multiramosa, bracteis acutis, firmis obtecta, bracteae usque ad 2 cm. longae; spathae firmae, acutae, ad 1.5 cm. longae, raro longiores, pluriflorae. Pedicelli tenues, spathas anthesin subexcedentes, glabri. Ovarium turbinatum, glabrum, ad 2 cm. longum. Perianthium flavum, atrolineatum; tepala subaequalia, elliptica, acuta, ad 9 mm. longa et 2.5 mm. lata. Filamenta ad 3 mm. longa, 1 mm. basi coalita; antherae lineares, 2.5 mm. longae. Stylus 1.5 mm. longus, styli rami 3 mm. longi. Capsula subglobosa, ad 6 mm. alta; semina complanato-globosa, ad 2.5 mm. lata, brunneo-nigra, sublucentia, irregulariter foveolata. BRAZIL: RIO GRANDE DO SUL: S. Leopoldo, in wet or marshy places, 17 Dec. 1948, *Rambo*, no. 38856 (GH); S. Leopoldo, Nov. 1941, *Leite*, no. 2032 (type, Arnold Arboretum); Vila Oliva, pr. Caxias, 2 Jan. 1946, *Rambo*, no. 33939 (GH).

The closest relatives of this new species are *S. macrocephalum* R. Grah. and *S. Wettsteinii* Hand.-Mazz. From both it differs in its larger size, smaller flowers, and, above all, in the inflorescence, which is very large, open, diffusely branched, with bracts covering most of the branches. The spathe-clusters are extremely numerous, appressed against the branches when young and becoming more divergent in maturity. It is probably the tallest species in the genus, since Father Rambo noted that the flowering stem may reach 2 meters in height. The specific epithet was chosen to show the striking resemblance to some bromeliad inflorescences.

Sisyrinchium deflexum, spec. nov. Herba perennis, tota glabra, rhizomatosa, rhizoma tenue, breve. Folia basalia nulla; folia caulina ad bracteas acutas, spathiformes, convolutas reducta, ad 2.5 cm. longa. Caulis simplex, ad 3.5 dm. altus. Spathae ad bracteas caulinas persimiles, ad 2.5 cm. longae, acutae, 1-florae. Pedicelli spathas anthesin excedentes, in fructu multo elongati et perdeflexi. Ovarium ad 2 mm. longum, turbinatum vel oblongum. Perianthium pallide flavum, non lineatum; tepala subaequalia, elliptica, subacuta, ad 8 mm. longa et 2 mm. lata. Filamenta circa 2.5 mm. longa, ad basin 1 mm. coalita; antherae lineares, 2-2.5 mm. longae. Stylus ad 2 mm. longus, styli rami circa 2 mm. longi. Capsula subglobosa, 3 mm. in diametro; semina immatura 1 mm. lata. PARAGUAY: in campo, Paso Yobaý, Dec. 1938, *F. Schade* (type, GH).

Beyond saying that this species is apparently a member of the *Marchio-vaginatum* complex, it is rather difficult to make any statement about relationships. It is distinctive in the complete similarity of cauline leaves and spathes, the latter being 1-flowered. Nowhere else in the genus have I seen solitary pedicels so strongly deflexed at maturity.

Sisyrinchium Reitzii, spec. nov. Herba perennis, tota dense pubescens, rhizoma tenue, breve vel breve substoloniferum. Folia basalia nulla; folia caulina ad bracteas acutas, spathiformes, convolutas reducta, ad 2.5 cm. longa. Caulis simplex, ad 30 cm. altus. Spathae ad bracteas caulinas persimiles, ad 1.5 cm. longae, acutae, 1-florae, vel raro 2-florae. Pedicelli spathas anthesin aequantes, glabri, in fructu nec elongati nec deflexi. Ovarium glabrum, subglobosum, ad 1.5 mm. longum. Perianthium flavum, non lineatum; tepala subaequalia, ad 8 mm. longa et 3 mm. lata, elliptica, apice breve mucronata. Filamenta ad 2.5 mm. longa, basi 1.5 mm. coalita; antherae lineares, 2 mm. longae. Stylus circa 2 mm. longus, styli rami circa 2 mm. longi. Capsula matura seminaque ignota. BRAZIL: São Paulo: Santo Amaro, 15 Apr. 1932, *Hauff*, no. 18 (GH); Santa Catarina: Morro do Iquererim, Campo Alegre, 1400 m., 5 Sept. 1957, *Reitz & Klein*, no. 4872 (type, US), 1500 m., 18 Oct. 1957, *Reitz & Klein*, no. 5228 (US).

Like *S. deflexum*, *S. Reitzii* is a member of the *Marchio-vaginatum* complex. Superficially, it bears a strong resemblance to *S. deflexum*. It differs, however, in the dense, short, grayish pubescence which covers leaves, stems and spathes. Sometimes the spathes are 2-flowered, rather than 1-flowered, but the pedicels are neither elongate nor deflexed in fruit. It has been named in honor of Father Raulino Reitz, the leading student of the flora of the state of Santa Catarina in Brazil.

CHROMOSOMAL RACES IN EASTERN NORTH AMERICAN SPECIES OF HEDYOTIS (HOUSTONIA)[1]

WALTER H. LEWIS AND EDWARD E. TERRELL

In a phylogenetic study of the North American species of *Hedyotis* (including *Houstonia*) (Rubiaceae), Lewis (1962 b) reported diploid and tetraploid races in populations of *H. caerulea*, *H. polypremoides* (Gray) Shinners, and *H. purpurea*. Reference was made to a more extensive study of the occurrence of infraspecific polyploidy. The purpose of this paper is to report these findings.

Chromosome numbers of 116 collections of species in the *H. caerulea* and *H. purpurea* groups were determined. P. M. C. meiosis or somewhat less frequently mitosis was studied in immature flower buds fixed in the field. The methods used to prepare slides were identical to those described for *Hedyotis* (Lewis, 1962b). In addition, representative permanent slides were mounted in euparal. Voucher specimens for each collection are filed in the herbaria of the U. S. National Museum (US), the Southern Methodist University (SMU), or Indiana University (IND; one collection).

The nomenclature of the *H. purpurea* complex follows the revision by Terrell (1959) except that the taxa are treated under *Hedyotis* rather than *Houstonia* (Lewis, 1961). This does not imply acceptance of *Hedyotis* by Terrell.

RESULTS

The chromosome numbers of *Hedyotis purpurea*, *H. longifolia*, *H. canadensis*, *H. nuttalliana* (= *Houstonia tenuifolia* Nutt.), *H. caerulea*, and *H. michauxii* (= *Houstonia serpyllifolia* Michx.), are listed with voucher data and, in parentheses, the number of plants examined. Although the chromosome numbers of several collections were published by Lewis (1962b), as indicated by an asterisk, they are included for completeness and as a basis for mapping.

[1]This study was supported by a grant to the first author from the National Science Foundation (G-9800).

1. *H. purpurea* (L.) T. & G.

1a. *H. purpurea* var. *purpurea*

n = 6. SOUTH CAROLINA: Edgefield Co., 4 miles WSW of Owdoms, *Terrell & Barclay 3430* (3). TEXAS: Newton Co., 2.8 miles S of Newton, *Lewis 5620* (5)*.

n = 6, n = 12. TENNESSEE: Polk Co., 0.5 mile N of Hwys. 64 & 30 junction, *Lewis 5638* (4 2*n*, 2 4*n*).

n = 12. GEORGIA: Gilmer Co., 3.9 miles NE of Ellijay,*Lewis 5645* (3). MARYLAND: Montgomery Co., Wheaton, *Terrell 3525* (4). NORTH CAROLINA: Guilford Co., Guilford College, *Terrell 3244* (1)*: Jackson Co., summit of Whitesides Mountain, *Terrell & Barclay 3472* (3); Macon Co., SE of Highlands, *Terrell & Barclay 3463* (2); Standing Indian Wildlife Management Area, *Terrell & Barclay 3478* (2). TENNESSEE: Cheatham Co., near Kingston Springs, *Terrell & Barclay 3360;* Cumberland Co., 1.5 miles W of Ozone, *Terrell & Barclay 3516* (3); Polk Co., 2.5 miles E of Hwys. 64 & 30 junction, *Lewis 5643* (atypical) (4); Sullivan Co., near Sullivan-Carter Co. line & Hwy. 19E, *Terrell & Barclay 3524* (3). VIRGINIA: Sussex Co., along Nottoway River W of Homeville, *Terrell 3636* (2).

1b. *H. purpurea* var. *calycosa* (Gray) Fosberg

n = 6. TENNESSEE: Wilson Co., Cedars of Lebanon State Park, *Terrell & Barclay 3339* (5); W border of Lebanon, *Terrell & Barclay 3340* (6).

n = 12. ALABAMA: Franklin Co., 7 miles E of Russellville, *Terrell & Barclay 3499* (3); just E of Russellville, *Terrell & Barclay 3361* (2); Jackson Co., 3 miles W of Scottsboro, *Terrell & Barclay 3485* (3). MISSISSIPPI: Carroll Co., 1.5 miles E of Carrolton, *Lewis 5634* (atypical) (3). TENNESSEE: Maury Co., 16 miles NW of Lewisburg, *Terrell & Barclay 3351* (4)*; Meigs Co., 7 miles S of Decatur, *Terrell & De Selm 3246* (1).

1c. *H. purpurea* var. *montana* (Small) Fosberg

n = 6. TENNESSEE-NORTH CAROLINA: Carter Co.-Mitchell Co., summit of Roan Mountain, *Terrell & Barclay 3615* (2).

2. *H. longifolia* (Gaertn.) Hook.

2a. *H. longifolia* var. *longifolia*

n = 6. MASSACHUSETTS: Middlesex Co., Horn Pond, Woburn, *E & B Terrell 3595* (3).

n = 6, n = 12. MINNESOTA: Chisago Co., St. Croix River at Taylors Falls, *Likhite*, July 1961 (2 2*n*, 5 4*n*).

n = 12. ONTARIO: Norfolk Co., Turkey Point, *C & M Heimburger*, 15 July 1961 (1).

2b. *H. longifolia* var. *compacta* (Terrell) Lewis

n = 6. GEORGIA: Meriwether Co., 5 miles W of Greenville, *Terrell & Barclay 3410* (2). NORTH CAROLINA: Alexander Co., base of Rocky Face Mountain, *Terrell 3257* (1)*. SOUTH CAROLINA: Abbeville Co., E side of Savannah River, *Terrell & Barclay 3424* (atypical) (1); Anderson Co., ca. 11 miles NNE of Anderson, *Terrell & Barclay*

3451 (2); Lexington Co., ca. 10 miles S of Columbia, *Terrell & Barclay 3444* (atypical) (3). VIRGINIA: Augusta Co., 11 miles NE of Hwys. 42 & 250 junction, *E & B Terrell 3569* (3); Frederick Co., 2 miles WNW of Gore, *E & B Terrell 3539* (2); Page Co.-Madison Co. line, Milepost 47, Skyline Drive, Shenandoah Natl. Pk., *E & B Terrell 3577* (3); Rappahannock Co., Hazel Mountain Overlook, Shenandoah Natl. Pk., *Terrell 60-11* (2) (no voucher); Shenandoah Co., 4.5 miles SW of Jerome, *E & B Terrell 3567* (3). Another collection is quite atypical: GEORGIA: Dade Co., Lookout Mountain, *Terrell & De Selm 3254* (1).

n = 12. MARYLAND: Frederick Co., Boonesboro Mountain Rd. & Hwy. 40 junction, *E & B Terrell 3533* (4). SOUTH CAROLINA: Edgefield Co., near Hwy. 378 & 67 junction, *Terrell & Barclay 3429* (3). VIRGINIA: Augusta Co.-Albemarle Co., 0.4 miles S of Milepost 97, Skyline Drive, Shenandoah Natl. Pk., *E & B Terrell* 3570 (3); Bedford Co., Milepost 90, Blue Ridge Parkway, *Terrell 3250* (2); Rockingham Co.-Greene Co., Sandy Bottom Overlook, Skyline Drive, Shenandoah Natl. Pk., *E & B Terrell 3573* (2). WEST VIRGINIA: Pendleton Co., 5 miles N of Hwy. 33 & Spruce Knob rd. junction, *E & B Terrell 3545* (3).

2c. *H. longifolia* var. *glabra* (Terrell) Lewis

n = 6. NORTH CAROLINA: Jackson Co., summit of Whitesides Mountain (type locality), *Terrell & Barclay 3473* (3); Macon Co., near Highlands, *Terrell 3255* (1)*; Slick Rock, SE of Highlands, *Terrell & Barclay 3464* (2).

3. *H. canadensis* (Willd. ex R. & S.) Fosberg

n = 6. TENNESSEE: Cheatham Co., near Kingston Springs, *Terrell & Barclay 3358* (4).

n = 12. INDIANA: Clark Co., 4 miles NW of Henryville, *Terrell 3251* (1)*. TENNESSEE: Marion Co., below Hales Bar Dam, *Terrell & Barclay 3480* (3). ONTARIO: Bruce Co., Bruce Peninsula, Red Bay, *Heimburger & Price*, 17 June 1961 (2).

4. *H. nuttalliana* Fosberg

n = 6. ALABAMA: Randolph Co., ca. 5 miles W of Wedowee, *Terrell & Barclay 3397* (4); Saint Clair Co., 0.5 mile W of Hwys. 35 & 53 junction, *Terrell & Barclay 3391* (3). ARKANSAS: Montgomery Co., 11.5 miles WSW of Norman, *Lewis 5169* (2)*. GEORGIA: Heard Co., 3 miles SW of Franklin, *Terrell & Barclay 3401* (5). NORTH CAROLINA: Stokes Co., Hanging Rock State Park, *Terrell 3243* (1)*. OKLAHOMA: Leflore Co., Lake Wister State Park, *Lewis 5161* (2)*. SOUTH CAROLINA: Lexington Co., ca. 4 miles E of Lexington Co.-Saluda Co. line, *Terrell & Barclay 3445* (3). VIRGINIA: Shenandoah Co., 2.6 miles E of Liberty Furnace, *E & B Terrell 3560* (3).

5. *H. caerulea* (L.) Hook.

5a. *H. caerulea* var. *caerulea*

n = 8. ALABAMA: Blount Co., ca. 3 miles E of Cullman, *Terrell*

& Barclay 3387 (3); Randolph Co., ca. 5 miles W of Wedowee, *Terrell & Barclay 3398* (3); Saint Clair Co., 0.5 mile W of Hwys. 35 & 53 junction, *Terrell & Barclay 3392* (3); Talladega Co., 2-3 miles W of Talladega Co.-Clay Co. line & Hwy. 77, *Terrell & Barclay 3396* (2). ARKANSAS: Clark Co., 2.4 miles SE of Alpine, *Lewis 5171* (3)*; Dallas Co., 1.9 miles S of Ouachita, *Lewis 5172* (3)*; Hot Spring Co., 1.5 miles NE of Donaldson, *Lewis 5613* (1). GEORGIA: Gilmer Co., 3.9 miles NE of Ellijay, *Lewis 5646* (1). INDIANA: Brown Co., near Trevlac, *Heiser & Ellis 4763* (IND) (3). KENTUCKY: Logan Co., 1.3 miles SW of Auburn, *Lewis 5602* (2); Metcalf Co., 3.1 miles E of Wisdom, *Lewis 5605* (4). NORTH CAROLINA: Alleghany Co., 2 miles NE of Blue Ridge Parkway & Hwy. 21 junction, *Terrell 3242* (2); Jackson Co., ca. 4 miles E of Cashiers, *Terrell & Barclay 3455* (3); Macon Co., Nantahala River & Hwy. 64, *Terrell & Barclay 3479* (3). SOUTH CAROLINA: Lexington Co., ca. 4 miles E of Lexington Co.-Saluda Co. line, *Terrell & Barclay 3446* (3). TENNESSEE: Cheatham Co., near Kingston Springs, *Terrell & Barclay 3359* (3); Stewart Co., 12.9 miles WSW of Dover, *Lewis 5601* (2); Kentucky Lake & Hwy. 79, *Lewis 5610* (2).

n = 9. ARKANSAS: Hot Spring Co., 3.6 miles NNE of Hwys. 67 & 210 junction, *Lewis 5612* (2).

n = 16. CONNECTICUT: Litchfield Co., 1-1/2 miles S of junction 112 & 7, Salisbury Twp., *Terrell 3662* (1); Tolland Co., 3 miles S of Rockville, *Terrell 3663* (2); near State Line Pond, *Terrell 3664* (3). MAINE: York Co., North Berwick, *E & B Terrell 3591* (1). MARYLAND: Frederick Co., Catoctin Creek & Hwy. 17, *E & B Terrell 3538* (1); Montgomery Co., Wheaton Regional Park, *Terrell 3526* (2). MASSACHUSETTS: Franklin Co., 3 miles S of Northfield, *Terrell 3667* (3); Worcester Co., 1/2 mile N of Hardwick, *Terrell 3665* (3). NEW HAMPSHIRE: Cheshire Co., 3 miles E of Winchester, *Terrell 3666* (1); Coos Co., lower slopes of Mount Washington (alt. 2500 ft.), *E & B Terrell 3589* (2); Grafton Co., Hanover, *Fosberg 39838* (2). NORTH CAROLINA: Guilford Co., Guilford College, *Terrell 3231* (5)*; Stokes Co., NW of Francisco, *Terrell 3239* (1)*. PENNSYLVANIA: Franklin Co., 0.5 mile N of Richmond Furnace, *Terrell 3629* (2); Juniata Co., 5 miles NE of East Waterford, *Terrell 3628* (4); Perry Co., 1 mile SE of Shermandale, *Terrell 3627* (3). SOUTH CAROLINA: Edgefield Co., ca. 4 miles WSW of Owdoms, *Terrell & Barclay 3431* (2). TENNESSEE: Cumberland Co., 7 miles SE of Mayland, *Terrell & Barclay 3514* (3); Knox Co., Knoxville, *De Selm*, 1 May 1962 (1). VERMONT: Windham Co., 2 miles W of Brattleboro, *Terrell 3668* (2). VIRGINIA: Hanover Co., 2 miles NW of Doswell, *Terrell 3631* (2); Page Co.-Madison Co., Big Meadows, Shenandoah Natl. Pk., *E & B Terrell 3575* (2). WEST VIRGINIA: Tucker Co., 8 miles S of Davis, *E & B Terrell 3544* (2); 1-2 miles N of Thomas, *E & B Terrell 3540* (1). ONTARIO: Toronto (introduced), *Heimburger*, 5 May 1961 (4) (omitted from map in Fig. 2).

n = 24. VIRGINIA: Sussex Co., along Nottoway River W of Homeville, *Terrell 3634* (1).

5b. *H. caerulea* var. *faxonorum* (Pease & Moore) Fosberg

n = 16. NEW HAMPSHIRE: Coos Co., below summit of Mount Washington (alt. 6000 ft.), *E & B Terrell 3586* (4).

6. *H. michauxii* Fosberg

n = 16. NORTH CAROLINA: Macon Co., Standing Indian Wildlife Area, *Terrell & Barclay 3477* (3); Transylvania Co., 0.5 mile N of Davidson River & Hwy 64 junction, *Terrell & Barclay 3460* (4). TENNESSEE: Monroe Co., Cherokee National Forest, *De Selm*, 1 May 1962 (3). TENNESSEE-NORTH CAROLINA: Carter Co.-Mitchell Co., summit of Roan Mountain, *Terrell & Barclay 3520* (5).

n = 24. NORTH CAROLINA: Alleghany Co., 2 miles NE of Blue Ridge Parkway & Hwy. 21 junction, *Terrell 3241* (1)*.

7. Putative hybrids or intergrading collections

7a. *H. longifolia—H. purpurea*

n = 6. SOUTH CAROLINA: McCormick Co., 2.5 miles NW of Mount Carmel, *Terrell & Barclay 3425* (1) (< longifolia).

n = 12. GEORGIA: Elbert Co., 2 miles W of Hwys. 72 & 79 junction, *Terrell & Barclay 3423* (2) (< longifolia); Rabun Co., ca. 7 miles S of North Carolina-Georgia line & Hwy. 28, *Terrell 3147* (1); Walton Co., 4 miles NE of Monroe, *Terrell & Barclay* 3420 (2) (< longifolia). TENNESSEE: Cumberland Co., 2 miles NW of Mayland, *Terrell & Barclay 3513* (3) (< purpurea).

7b. *H. canadensis* > — *H. purpurea*

n = 12. INDIANA: Clark Co., 4 miles NW of Henryville, *Terrell 3252* (1).

7c. *H. caerulea—H. michauxii*

n = 16. WEST VIRGINIA: Tucker Co., just above Blackwater Falls, *E & B Terrell 3542* (5).

DISCUSSION

The basic chromosome number of *Hedyotis purpurea*, *H. longifolia*, *H. canadensis*, and *H. nuttalliana* is $x = 6$. The basic chromosome number of *H. caerulea* and *H. michauxii* is $x = 8$. These data agree with the morphological evidence: the first four species are closely related and were included by Terrell (1959) in the *H. purpurea* group; the last two species are so alike that herbarium material sometimes is difficult to distinguish.

A dash, —, is used here to indicate morphological intergradation. The second author prefers to use this symbol instead of ×, as in this case additional knowledge about the species is needed to attribute their intermediacy to hybridization. He believes that botanists should restrict the use of × to instances in which evidence of hybridization has been thoroughly studied. The symbols > and < were used by others (cf. Li, 1957; Hardin, 1958). For example, *H. canadensis* > — *H. purpurea* denotes specimens which intergrade but are more similar to the former species.

In *H. purpurea* (Fig. 1) our sampling indicates that tetraploid populations are in the great majority. The only known $2n$ populations are in the southern part of the range. One population included both $2n$ and $4n$ individuals. The sampling is not sufficient to show any geographic separation of chromosomal races, if such exists. Var. *montana*, the only known stations for which are on Roan Mountain and Grandfather Mountain, is diploid at the former station (not shown in Fig. 1).

In contrast to *H. purpurea*, *H. longifolia* has almost twice as many $2n$ populations as $4n$. These are found in the north

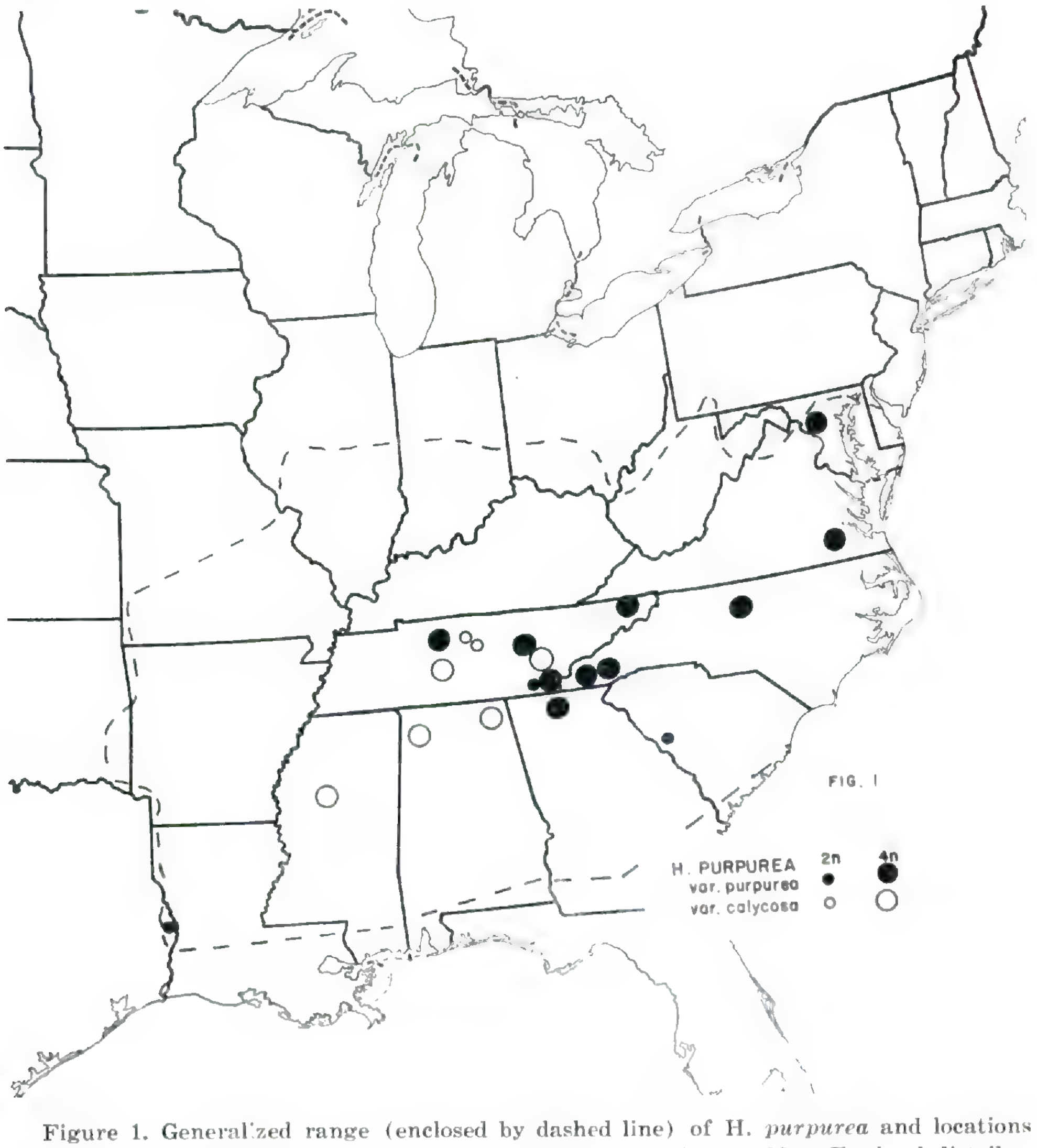

Figure 1. Generalized range (enclosed by dashed line) of H. *purpurea* and locations of diploid and tetraploid collections. Var. *montana* not shown. New England distribution of var. *calycosa* not shown.

as well as in the south, and one population in Minnesota contains individuals with both chromosome numbers. Var. *glabra*, restricted to the southern Appalachians, is diploid on the basis of three collections.

Plants of *H. canadensis* from only four localities were studied but these included samples from the extremes of the species range in Tennessee and Ontario. On the basis of the small sample, the tetraploids prevail over the diploids in a proportion similar to that for *H. purpurea*. With both $2n$ and $4n$ races in Tennessee, no geographic separation of the forms is apparent. Only $2n$ individuals were found among plants of *H. nuttalliana* from 8 stations in 7 states, from Virginia to Oklahoma. This sample is sufficiently large and widespread to indicate that tetraploid individuals must be rare in *H. nuttalliana* if they exist. Infraspecific polyploidy is probably unimportant in the recent evolution of the species. On the basis of the frequency of diploidy and tetraploidy, with the high frequency of tetraploidy representing the higher stage of evolution, the species in the $x = 6$ group can be ranked from the simplest to the most specialized as: *H. nuttalliana* ($2n$ only), *H. longifolia* ($2n:4n = 2:1$), *H. purpurea* and *H. canadensis* ($2n:4n = 1:3$). Using this criterion, *H. nuttalliana* is the least evolved species of the series, a position corroborating the results of Lewis (1962b) based chiefly on morphological evidence.

Among 45 collections of *H. caerulea* var. *caerulea* sampled from a wide area of the species range, 18 were diploid ($n = 8$), 25 were tetraploid ($n = 16$), one was aneuploid ($n = 9$), and one was hexaploid ($n = 24$). Thus, this species consists predominantly of $2n$ and $4n$ populations, with the latter slightly outnumbering the former in our sample. The base number is $x = 8$. The chromosomal races appear to have partly distinct distributions: the diploid race is widely distributed in the southern United States (Fig. 2) and in our sample occurs only south of the glacial boundary. Only tetraploids are known in New England, but they do occur also in certain parts of the South. The single collection of var. *faxonorum*, a variety restricted primarily to higher altitudes in the White Mountains, was tetraploid.

On the basis of a single population of *H. michauxii*, Lewis

(1962b) reported the species as hexaploid. Additional sampling has shown, however, that $4n$ and $6n$ races exist, the former occurring much more frequently. The species is limited in distribution to the higher regions of the southern and central Appalachians, a distribution interestingly associated with the finding of two polyploid races and no diploid forms in a subgenus where "pure" polyploid species are infrequent.

In the P. M. C.'s of all plants examined, bivalent formation and separation by and large were regular. Occasionally 1 to 3 quadrivalents were observed at metaphase I in the $4n$ plants (e.g., *H. purpurea, Terrell & Barclay 3351; H. caeru-*

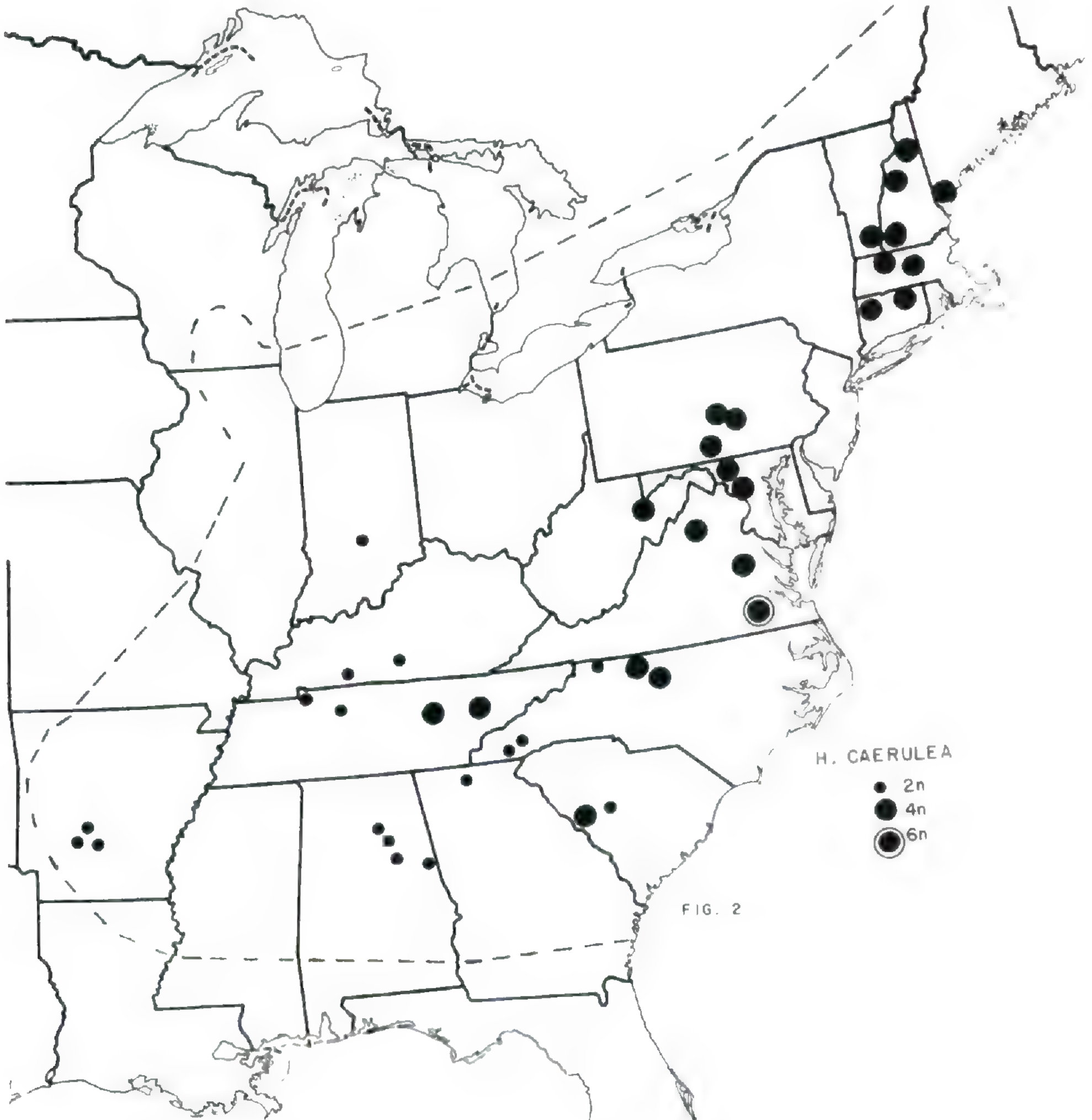

FIG. 2

Figure 2. Generalized range (enclosed by dashed line) of *H. caerulea* and locations of diploid and polyploid collections. The single aneuploid (n = 9) collection not shown.

lea, Terrell 3627), but these were exceptional. Spindle disturbances were not observed. In one cell, a plant of *H. caerulea (Lewis 5610)* had $2n = 15$, but all other mitotic cells had $2n = 16$ and in the P. M. C.'s $n = 8$. Although statistical data are not available, plump, well-stained pollen grains were noted for most diploids and tetraploids. If the fertility of the tetraploids was decreased markedly in comparison with the diploids it was not apparent from observations of pollen.

Seven collections were of intermediate or intergrading morphology. Certain of these are putative hybrids. As no definite evidence of hybridization is available, we are using a dash (—) to connect the two names. This is intended to indicate intergradation without necessarily suggesting hybridization as its cause. In the seven collections diploid and tetraploid populations were found, with the latter more frequent. Of the five collections of *H. purpurea — H. longifolia*, a diploid *(Terrell & Barclay 3425)* had regular pairing at metaphase I as did all P. M. C.'s examined from the tetraploid individuals of *T. & B. 3420* and *3513*. Only mitosis was observed in the other two collections of *H. longifolia — H. purpurea* and in *H. canadensis — H. purpurea*. Meiosis in *H. caerulea — H. michauxii* was regular; this population is not thought to be of hybrid origin. Pollen was more or less normal in individuals of the seven collections. In general, the chromosome data indicate that chromosome number *per se* is no barrier to hybridization in these species within each ploidy level, i.e. $x = 6$ and $x = 8$. The chromosome numbers in the *H. purpurea* group are entirely compatible with the data from morphology expressed in the taxonomic treatment of this group by Terrell (1959) but the few admittedly preliminary chromosome counts listed in the same paper should be ignored.

As more cyto-population research is completed, it becomes apparent that varying chromosome numbers for a species are much more common than hitherto suspected. In the Rubiaceae alone, where very few cytological studies have been completed, infraspecific polyploidy has been recorded for species of 13 genera, particularly in the Rubieae (Fagerlind, 1937; Ehrendorfer, 1961), *Coffea* and *Coprosma* (cf.

Darlington & Wylie, 1956), *Bouvardia* (Lewis, 1962a), and *Hedyotis* subg. Oldenlandia (Lewis, 1959, 1962b).

In *Hedyotis* subg. Edrisia, in which the species under discussion are classified, chromosome numbers of 25 species are known (Lewis, 1962b). Of these, seventeen species are diploid, four species are diploid and tetraploid, one species is diploid, tetraploid, and hexaploid, two species are tetraploid, and one species is tetraploid and hexaploid. Twenty-three species are euploid and two have recorded aneuploid individuals. Thus six species or 24% of the North American species studied have infraspecific polyploidy, 4% exhibit infraspecific aneuploidy, and 4% exhibit both infraspecific polyploidy and aneuploidy. All of these species are heterostylous perennials and with one exception are herbaceous. No chromosomal plasticity is known among the eight annual species of the subgenus or among the species having only short-styled flowers. This suggests a certain correlation in the subgenus between the heterostylous species constructed for outbreeding and the perennial habit with the occurrence of infraspecific polyploidy and aneuploidy.

The distributions of the diploid and tetraploid races of *H. caerulea*, *H. purpurea*, and *H. longifolia* may be grouped into two categories, viz., those with different geographic distributions and those without such tendencies. As an example of the first kind, the $2n$ race of *H. caerulea* occupies a southern range while the $4n$ race has a more northern distribution. Possibly the tetraploid race colonized areas drastically altered by glaciation in the northern region of the species' present range, while the ancestral race remained predominantly south of the glacial boundary (cf. Stebbins, 1950). It also appears that the $4n$ race is now successfully competing with the $2n$ race somewhat south of the southern limits of the last glaciation. The high altitude distribution and the polyploid races of *H. michauxii* also suggest the colonization of less favorable environments by a polyploid species. That this tendency is not universal, even for species in the same subgenus, is suggested by the infraspecific distributions for *H. purpurea* and *H. longifolia*. Their diploid and tetraploid races are about equally distributed and do not appear to have

either peripheral or central concentrations although we did not sample their entire ranges.

When herbarium specimens from all of these collections were compared, tetraploid and diploid (and hexaploid) plants of each taxon looked just alike; there were no observable gross morphological differences in plants of different ploidy levels and it is clear that these are autopolyploids. Five out of the six species had polyploid populations. Autopolyploidy is an essential feature of the evolution of the *H. caerulea* and *H. purpurea* groups.

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A NEW CRUCIFER FROM THE GREAT SLAVE LAKE AREA OF CANADA

Reed C. Rollins

A general problem of classification in the Cruciferae results from the lack of sharp definitive boundaries between the genera in some sections of the family. This problem has long been recognized. The situation is readily understood and should perhaps even be expected because of the relatively short evolutionary history of the family. However, an understanding of the situation does not alleviate the torment that ensues whenever an unknown species is found that does not quite fit well-established genera. The uncertainty as to which genus might be involved requires that all possible genera be carefully checked and studied to determine whether or not the species has been described in any one of them. This in itself is a much longer and more laborious process than if the species were clearly referable to a well known and well defined genus. Furthermore, the unknown species is usually not closely related or readily comparable to a known species and thus the comparative procedures usually employed in fitting such a species into a classificatory scheme are not applicable.

For over a year, we have been periodically concerning ourselves with material of just such an unknown species. Four collections of it were made by John W. Thieret and Robert J. Reich, along the Yellowknife Highway near Great Slave Lake of northwestern Canada, during June and July of 1961. A fifth collection was made in August, 1962, by Thieret. The plants grow in marshy to wet situations and develop relatively large lateral roots. The petiolate basal leaves with more or less crenate margins are reminiscent of *Armoracia aquatica* or possibly horseradish, *Armoracia rusticana*, but there the similarity stops. The long, slender, wide-spreading pedicels suggest *Rorippa nasturtium-aquaticum*. However, other features, such as the undivided leaves and uniseriate seeds, make a close association of the plant in question with watercress untenable. All characteristics considered, the new species does fall more nearly within the group of species making up *Rorippa* than any

Plate 1271. Silhouette photograph of two fertile specimens and one sterile specimen of *Rorippa crystallina*, × 2/5. The specimen at right and the sterile specimen make up a part of the holotype sheet.

other genus known to me, even though no single species can readily be singled out for easily handled comparative purposes.

An interesting feature of the new species is the basis for the specific epithet chosen, *crystallina*.[1] Relatively large crystals of calcium oxalate are found in the inner tissues of the fleshy leaves, the stems, pedicels and fruits. These crystals occupy several adjacent cells and are large enough to erupt the leaf-surface when the plants are pressed flat in drying them for specimen purposes. According to Metcalfe and Chalk[2] calcium oxalate crystals are rare in the Cruciferae. These authors indicate that crystals are present in *Crambe* and *Sisymbrium* but *Rorippa* is not mentioned as a genus in which calcium oxalate crystals have been observed. The number and distribution of crystals in *Rorippa crystallina* is variable. These crystals may be clustered or widely spaced, associated with or near vascular bundles, or remote from them. There is no evident association with vascular trace endings in the leaves. In the larger basal leaves, the crystals are more prominent and more numerous on the lower side of the leaf than on the upper. They are more numerous per unit of area in the smaller cauline leaves than in the basal leaves and give a pustular appearance to the leaf-surface, both above and below. Generally, they are more prominent on the lower surface than on the upper.

Rorippa crystallina Rollins, sp. nov. Plate 1271

Perennial, glabrous throughout; roots thick, often well-developed laterally; stems one to several, erect to decumbent, glabrous, 1-4 dm. long, arising below an active fascicle of leaves, unbranched except in the inflorescence; basal leaves borne on short shoots,fascicled, petiolate, ovate to narrower, obtuse, shallowly and coarsely dentate, blade 4-10 (-20) cm. long, 1.5-4 (-6) cm. wide, cuneate at base, petioles 3-8 (-12) cm. long, winged above; lower cauline leaves petiolate, narrowly oblanceolate, obtuse, 4-6 cm. long, 4-10 mm. wide, dentate, toothed or lobed, petiole winged; upper cauline leaves sessile, overlapping, lanceolate to nearly oblong, narrowed at base, entire to sparsely dentate, thick when fresh; all leaves more or less pustular on both

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[1]I am indebted to Professors I. W. Bailey and Adriance S. Foster for cleared leaves, tests for calcium oxalate and shared observations on the material. My appreciation goes to Dr. John W. Thieret for providing ample material upon which this study is based.

[2]Anatomy of the Diocotyledons, Vol. 1, p. 82. 1950.

surfaces from the presence of relatively large crystals present in the mesophyll; individual stems terminated by a short raceme 5-10 (-15) cm. long, occasional flowering branches just below main inflorescence; sepals yellowish-green, non-saccate, broadly oblong, 4-5 mm. long; petals spatulate, whitish, sometimes tinged below with light lavender, 6-8 mm. long, ca. 3 mm. wide; stamens tetradynamous. anthers oblong, ca. 1 mm. long; fruiting pedicels slender, spreading at right angles to somewhat ascending, 12-18 mm. long, slightly enlarged at apex; siliques terete, 1.5-2.5 cm. long, widely spreading to somewhat ascending, nearly sessile or with a short thick gynophore less than 0.5 mm. long; valves with a central inconspicuous branching nerve; styles ca. 1 mm. long; stigmas slightly bilobed with lobes over the replum; ovules 10-15 in each loculus; funiculi free, rather spongy; septum with a prominent central nerve-like area extending full length down the middle, cells of the septum prominent, usually hexagonal; seeds plump, broadly oblong, wingless, 1.5-2 mm. long, ca. 1.2 mm. broad; seed-coat finely reticulate-colliculate, covered with a mucilaginous sheath, buff-colored when dry, beak curved into a short hook, funiculus detached at hilum leaving a circular scar, funicular appendage absent; cotyledons accumbent.

Herba perennis caespitosa glabra, caulibus erectis vel decumbentibus 1-4 dm. longis; foliis pustulatis, basilaribus fasciculatis petiolatis, laminis ad basim cuneatis ovatis vel anguste-ovatis dentatis 4-10 cm. longis, 1.5-4 cm. latis; foliis caulinis inferne crassis petiolatis anguste oblanceolatis dentatis vel lobatis; foliis caulinis superne sessilibus crassis integris vel sinuato-dentatis obtusis; sepalis nonsaccatis obtusis 4-5 mm. longis; petalis spathulatis albis vel albido-lilacinis 6.5-8 mm. longis; pedicellis in fructu divaricatis tenuis 12-18 mm. longis; siliquis teretibus divaricatis 1.5-2.5 cm. longis; stylis ca. 1 mm. longis; seminibus oblongis immarginatis 1.5-2 mm. longis; cotyledonibus accumbentibus.

Type in the Gray Herbarium collected in a Carex marsh at mile 23 N., along the Mackenzie River - Yellowknife Highway, northwest of Great Slave Lake, District of Mackenzie, Northwest Territories, Canada, July 10, 1961, *John W. Thieret and Robert J. Reich 7512.*

Other specimens studied, all from the same general area, and deposited in the Gray Herbarium: mile 23.8 N., June 14, 1961, *Thieret and Reich 6637;* mile 35 N., July 7, 1961, *Thieret and Reich 7413;* mile 16.5 N., July 9, 1961, *Thieret and Reich 7484;* mile 23.5 N., Aug. 9, 1962, *Thieret 9085.* — GRAY HERBARIUM, HARVARD UNIVERSITY.

TWO NEW VARIETIES AND A NEW COMBINATION IN RUDBECKIA

ROBERT E. PERDUE, JR.[1]

Rudbeckia nitida Nutt. var. **texana** Perdue *var. nov.* Folia integra, crenata, dentata, vel serrata, dentibus (si adsint) numerosis crebris 10 vel pluribus quoque in margine; folia basalia anguste vel late elliptica vel spatulata. Discus 2.0-4.5 cm. altus, achaenia 5.0-7.5 mm. longa.

Leaves entire, crenate, dentate, or serrate, teeth abundant if present, basal leaves narrowly to broadly elliptic, or spatulate, blade 10-15 cm. long, 3-6 cm. wide, sharply or broadly acute, attenuate below to a long slender petiole; disk conical to conic-cylindrical, 2.0-4.5 cm. long; achenes 5.0-7.5 mm. long.

TYPE: In prairie along railroad, 6 miles S. of Stowell, Chambers Co., Texas. *L. H. Shinners 7710,* May 15, 1945 (SMU).

DISTRIBUTION: Low open areas along roadsides and in fields; southeastern Texas to central Louisiana.

This is a morphologically distinct variety separated geographically from *R. nitida* var. *nitida* of eastern Georgia and northeastern Florida by more than 400 miles. The abundently toothed, crenate, dentate, or serrate leaves of *R. nitida* var. *texana* readily distinguish it from the eastern variety. The latter characteristically bears leaves with 4 to 8, distantly and more or less equally spaced small dentate teeth on each margin.

Considerable justification could be offered to support the description of this variety as a new species. On the other hand, the conservative treatment I have applied to this and related Rudbeckias provides a better arrangement for indicating the relationships of the taxa.

Rudbeckia laciniata L. var. **bipinnata** Perdue *var. nov.* Folia caulina inferiora et mediocria bipinnatifida vel pinnatisecta, segmentis vel foliolis 5-7, pinnatifidis, segmetis ultimis lanceolatis. Discus globosus vel ovoideus 1.5-1.9 cm. altus.

Stems 0.6-1.5 m. high, mostly slender, the peduncles rarely more than 1.5 mm. in diameter; basal leaves not seen, lower and middle stem leaves petiolate, bi-pinnatifid or pinnately divided into 5 or 7 irregularly pinnatifid leaflets or segments, the ultimate divisions lanceolate, entire or coarsely toothed, upper stem leaves similar but with fewer divisions, sessile, the uppermost merely 3-lobed or entire

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and ovate; heads mostly 8-15; rays 4.0 (3.5)-5.0 cm. long; disks globose to ovoid, 1.5-1.9 cm. long; achenes 4-6 mm. high.

TYPE: Swampy open woods along Mud Creek, valley of Fall Creek, Dryden, Tompkins Co., New York, *MacDaniels & Eames 1293*, August 10, 1913 (GH).

DISTRIBUTION: Moist open or partly shaded sites: stream banks, meadows, borders of woodland, open woods, etc.; Massachusetts and New Hampshire to eastern Pennsylvania and Maryland.

R. laciniata var. *bipinnata* is intermediate between the common *R. laciniata* var. *laciniata* of the eastern United States and Canada, with which it intergrades imperceptibly, and *R. laciniata* var. *digitata* (Mill.) Fiori of the northern half of the Atlantic coastal plain. From var. *laciniata* the new variety is distinguished by its bipinnatifid leaves with narrowly lanceolate or linear-lanceolate ultimate segments. From var. *digitata* it is distinguished by its larger disks (1.5 cm. or more high) and longer rays (3.5 to 6.0 cm. long).

Rudbeckia occidentalis Nutt. var. **montana** (Gray) Perdue, *comb. nov.* Based on *R. montana* Gray, Proc. Amer. Acad. 17: 217 (1881-1882).

A NEW SPECIES OF SETCREASEA FROM MEXICO

SHAMIM A. FARUQI,[1] K. L. MEHRA,[2] AND R. P. CELARIER[3]

The authors came across a new species of the genus *Setcreasea* from Mexico, collected by Edward Palmer, first identified as *S. pallida*, but later as "*S. palmeri*" probably by Rose, who, it seems, did not get a chance to describe it. Rose (1891) did report another new species, *Tradescantia palmeri*, from Edward Palmer's collections of Mexico. Though the genus *Setcreasea* was separated from *Tradescantia* at a later date (Rose 1899, 1903, Schumann et Sydow 1899) on the basis of fused corolla and epipetalous stamens, the species *T. palmeri* should not be confused with this new species, because *T. palmeri* is in no way similar to it.

[1]At present: Cameron State Agricultural College, Lawton, Oklahoma.

[2]At present: Division of Botany, Indian Agricultural Research Institute, New Delhi, India.

[3]Deceased December 23, 1959.

On the strength of its dense-woolly trichomes on leaf, leaf sheath, and pedicel, in combination with thick connective, and pubescent ovary, we believe that the present taxon is a new species. The name "*S. palmeri*" is not taken into consideration to avoid a nomenclatural confusion.

Setcreasea lanceolata Faruqi, Mehra & Celarier, sp. nov.

Herba perennis, caulibus subramosis, erectis, glabratis, foliis lanceolatis, pilosis, vaginis pilosis, usque 1.8 cm longis, calycibus pilosis, ovario piloso.

Perennial herbs, 20-25 cm high; rhizomes creeping; roots arising from the underground nodes, fleshy and slender; aerial stems few, succulent, erect or slightly decumbent, glabrous, striate when dry, the internodes 5.5-8 cm long, those bearing inflorescences 6.8-10.2 cm long; lamina sessile, lanceolate, oblong or rarely elliptic, 10-15 cm long, 2.5-3 cm wide, acute at the apex, sheath prominent, up to 1.8 cm long, both the lamina and the sheath dense-woolly; inflorescences terminal subtended by 2 leaf-like bracts, bracts lanceolate, the outer 4.0 cm long, 2.0 cm wide, the inner 1.8 cm long, 2.0 cm wide; flowers several, pedicellate, the pedicels 6.0 mm long, woolly; sepals subequal, elliptic, 5.5 mm long, 2.0 mm wide; corolla "purple white with a bar of purple color in the center of the limb"[4], gamopetalous, the tube conspicuous, 2.0 mm long; stamens 6, epipetalous, subequal, filaments barbate, the connective thick and broad; ovary tricarpellary and pubescent; stigma capitate, 3-lobed; fruit a three-chambered capsule; seeds dark gray 1-2 in each locule.

Mexico: San Louis Potosi, Edward Palmer 135 (GH type, US).

RELATIONSHIPS

Setcreasea lanceolata may show a superficial resemblance to *S. hirsuta* Markgraf (1952). It differs from *S. hirsuta* in its densely pubescent leaves, sepals and ovary. According to Markgraf's description *S. hirsuta* is pubescent only at leaf bases while its calyx and ovary are glabrous.

In spite of the differences in size and shape of leaf, and pubescence of leaf and calyx, *S. lanceolata* shares two very important characteristics with *S. brevifolia*, i.e., highly pubescent ovary and thick connectives. The evolutionary pattern indicates, that in the genus *Setcreasea* leaf size and shape have undergone many more changes than ovary and stamen. Thus, similarities of connectives and ovary may indicate a closer ancestral relationship of *S. lanceolata* and *S. brevifolia* than any other species of this genus.

[4]Annotation on the herbarium sheet.

ACKNOWLEDGEMENTS

The authors are thankful to the curators of the Gray Herbarium of Harvard University and United States National Herbarium for the loan of the herbarium specimens, and to Dr. Shiu Ying Hu of Arnold Arboretum, Harvard University, for reading the manuscript.—
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THE PARASITIC BEHAVIOR OF DASISTOMA MACROPHYLLA[1]

MARTIN A. PIEHL

The first and perhaps only reference to the parasitic behavior of *Dasistoma macrophylla* (Nutt.) Raf. appears to be that of Pennell (1928), who in the course of his primarily taxonomic studies of the Scrophulariaceae observed parasitic attachments to buckeye, *Aesculus glabra* Willd., in Indiana. In the same paper he lists *Dasistoma* as one of the genera which may be restricted to a single host. That he had probably not learned of additional hosts in the years shortly after this observation is indicated by the fact that he stated simply that *Dasistoma* "is parasitic upon the roots of *Aesculus*" (Pennell, 1935, p. 405).

Further information on this point has been recently received from Professor Edgar T. Wherry of the University of Pennsylvania who relates an incident when Pennell noted disagreement in the ranges of *Dasistoma* and *Aesculus*

[1]Facilities for this study were provided by the Department of Botany, University of Michigan, Ann Arbor, where the author was engaged in doctoral studies.

glabra in Indiana, he communicated with C. C. Deam, saying that he felt further study would show that *Aesculus* was present wherever *Dasistoma* was. After further consideration of the range of *Aesculus* in that state, Deam agreed that this was true. Thus, it would appear that Pennell felt this species was an obligate parasite on *Aesculus*. A parallel situation has been carried in the literature for many years with regard to the host specificity of *Buckleya distichophylla* Torr., which is claimed to be restricted to hemlock, *Tsuga* (e.g., see Fernald, 1950). Such (presumed) highly specialized host-parasite relationships are to be doubted when one considers that all other chlorophyllous parasites[2] of the Scrophulariaceae and Santalaceae that have been studied in some detail are known to parasitize a number of hosts.

The present study was made to determine if *Dasistoma* does in fact parasitize other plants as well, thereby making it possible (if it is an obligate parasite) for it to grow in areas where *Aesculus* is absent. Further, within the Scrophulariaceae, observations on parasitism are lacking for the tribe Buchneriae, to which *Dasistoma* belongs, except for some species of *Gerardia* L. (*Agalinis* Raf.). Most previous observations are for the members of the Euphrasiae. None of the several manuals consulted (e.g., Fernald, 1950; Gleason, 1952) which cover the range of this species have included the fact that this relatively little known plant is parasitic.

As Pennell (1928, 1935) has indicated, there have been long-term differences of opinion and confusion concerning the placement of this species as to genus. It was given the name *Dasistoma (aurea)* by Rafinesque (1819), who later (1837) apparently gave it a new name *Dasistema (auriculata)*. Bentham (1846) altered the spelling to *Dasystoma*, but misidentified Rafinesque's description, applying the name not to this plant but to *Aureolaria* Raf. Nuttall (1818) placed it in his genus *Seymeria*, where it has been maintained in some recent works (e.g., Fernald, 1950). I have

[2]Such photosynthetic parasites which obtain only a portion of their total nutrition from hosts are often referred to as semi-, half-, or partial parasites. Present knowledge concerning the role of parasitism in the life of such plants indicates that although they may persist for a limited time without hosts, parasitism is necessary for optimum development and sexual reproduction.

followed Pennell who treated it as a monotypic genus, *Dasistoma.*

Dasistoma macrophylla is a robust, yellow-flowered herb becoming 1-2 m. tall, and bearing large, dissected or pinnatifid lower leaves and narrower upper leaves which are merely toothed. Although it is described as an annual (Pennell, 1928; Gleason, 1952), the plants studied appeared to be biennial, or perhaps even perennial. Its roots are much larger than those I have examined for any of the truly annual parasitic Scrophulariaceae. Young, rosette-forming plants were found in the autumn that would presumably develop into flowering individuals the following summer, as I have noted for the related *Aureolaria pedicularia* (L.) Raf. The common name bestowed upon *Dasistoma,* mullein-foxglove (Fernald, 1950), is probably less well known and certainly more confusing than the scientific name.

This species is limited to the central states, ranging from northwestern Georgia to northeastern Texas, north to eastern Nebraska, southern Wisconsin, and northern Ohio. The observations discussed here were made in October, 1959 in Mercer County, Kentucky, 5 miles northeast of Shakertown near U. S. Route 68, in hilly, conifer-hardwood woodland over limestone. The associated species apparent at that season were *Juniperus virginiana* L., *Ostrya virginiana* (Mill.) K. Koch, *Quercus* cf. *muehlenbergii* Engelm., *Q. rubra* L., *Carya* sp., *Ulmus americana* L., *Celtis tenuifolia* Nutt., *Cercis canadensis* L., *Acer saccharum* Marsh., *Fraxinus quadrangulata* Michx., *Panicum* sp., and *Aster shortii* Lindl.

Parasitic connections were detected to the roots of two species: American elm *(Ulmus americana)* and sugar maple *(Acer saccharum)*, with additional connections to what was probably a third, unidentified, woody host. Since numerous haustoria are formed by a single plant, simultaneous connections to two or more different hosts is the rule (Figs. A and C). Self-parasitic connections to the roots of the same or other individuals of *Dasistoma* were almost as frequent as those to foreign roots. In addition to their surprisingly high frequency (other root parasites have far fewer), some of the self-parasitic connections were unusual in that they lacked a distinct haustorium, the connection being suggestive

of simple root grafting. Perhaps further observations will determine whether such occurrences, which may be of considerable ecological significance, are common in such plants.

The root system of *Dasistoma* resembles that of many parasitic Scrophulariaceae in that it is whitish or light tan when fresh, but will blacken quickly upon drying. The usu-

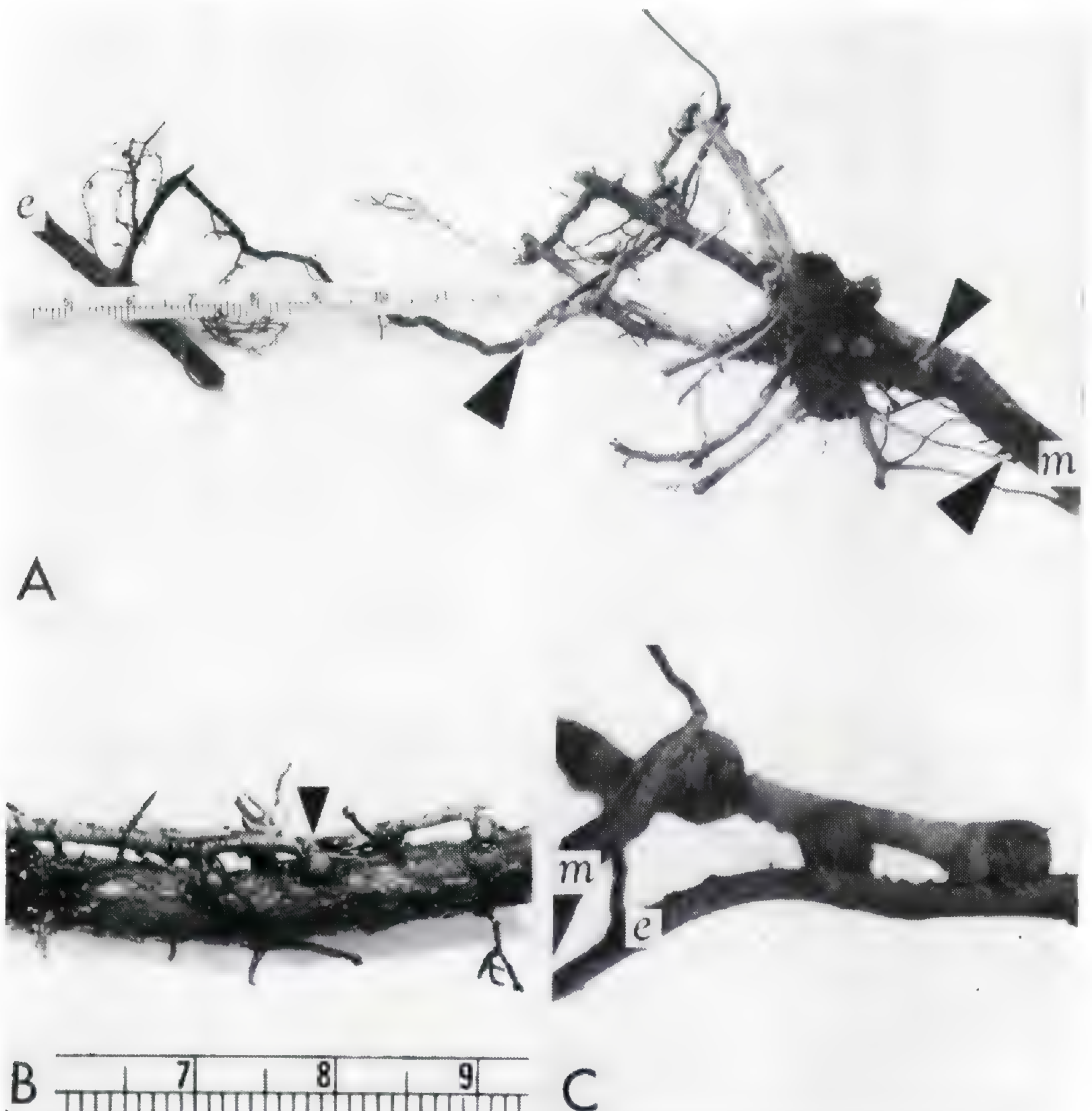

Plate 1272

Figures A-C. Parasitic connections of *Dasistoma macrophylla*. A. Haustoria of a single plant on roots of American elm (e) and sugar maple (m). Both large and relatively small haustoria are visible at the right on maple (pointers); near the center, three haustoria produced in rather close successsion on elm are indicated. At the right the crown and large roots of the parasite are concentrated about roots of maple. B. *Dasistoma* root (above) paralleling a maple root to which primarily single haustoria have attached (pointer). Another haustorium is visible at the extreme right (parasite root has been severed just beyond). C. Haustoria of a single *Dasistoma* root attached both to elm and maple roots. Distal to the point of attachment, a marked decrease in the diameter of the maple root is visible, × 2.5

ally disc-like haustoria, which are commonly hemispherical in vertical outline and from circular to broadly oblong in surface view, ranged from 0.5-6.0 mm. in width.

Dasistoma haustoria differ rather markedly from those of such members of the Euphrasiae as *Melampyrum lineare* Desr. (Piehl, 1962) and *Pedicularis canadensis* L. (Piehl, in press) in the following ways. They are larger on the average and lack the epidermal hairs found on some haustoria of these species. Also, they are produced from large as well as fine roots, and more frequently form attachments to larger (diameters up to 7 cm.) host organs. The larger haustoria-bearing roots, particularly, remain intact during excavation, making the observation of connections considerably easier. Another distinctive feature involving an abrupt decrease in the diameter of maple roots distal to the haustorium was noted occasionally (Fig. C) ; in an extreme case the development of the distal portion of roots 2.5 mm. in diameter had been arrested completely so that the host root appeared to terminate at the haustorium. The crown and large roots of *Dasistoma* differ from the above Euphrasiae in being concentrated near rather large host roots (Fig. A), the parasite roots sometimes tending to partly surround them in a manner which has its most extreme expression (in temperate North America) in certain non-green parasites, e.g., *Epifagus*. The haustoria tend to simulate those of the Euphrasiae in the mode of attachment to and penetration of host organs, and also in being produced both singly and in close succession.

It is the author's opinion that further study would show that a number of other species, the majority of them woody, serve as hosts as well. It remains to be determined if herbaceous plants also act as hosts, and if so, whether the parasite would grow as well if restricted to such plants as grasses, a situation which would involve smaller, but perhaps more numerous haustoria. — SANTA BARBARA BOTANIC GARDEN, SANTA BARBARA, CALIFORNIA.

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HETEROMORPHIC POLLEN GRAINS IN POLYMNIA[1]

T. RICHARD FISHER AND JAMES R. WELLS

During the course of a biosystematic study of the genus *Polymnia*, it was discovered that one population (Wells 254) of *P. laevigata* Beadle contained an extremely high percentage of different pollen shapes and sizes. This collection was taken from a population 5 miles southeast of Monteagle, Tennessee on U. S. Route 41. The plant was transplanted to the greenhouse and all pollen samples were taken from the living plant. This station was made known from previous collections of Ford and Russell for the University of Tennessee in 1946. Flowering heads were preserved in 3 parts 95% ethyl alcohol and 1 part acetic acid. The immature pollen was stained with aceto-carmine and studied for overall shape and number of nuclei. Aniline blue in lactophenol was used to study stainability of the mature pollen grains. Voucher slides are on deposit at The Ohio State University.

RESULTS

From observation of several hundred pollen grains, five morphological types were easily discerned as follows:

[1]Publication 675, The Department of Botany and Plant Pathology, The Ohio State University, Columbus 10, Ohio.

1. uninucleate and spherical (fig. 2, 3, 5)
2. binucleate and elliptical (fig. 4)
3. trinucleate and kidney bean-shaped (fig. 3)
4. trinucleate and ovoid (fig. 4)
5. quadrinucleate and spherical (fig. 2, 5)

The above morphological forms were placed in four groups based on the number of nuclei in each pollen grain (table 1). In a sample of 500 randomly selected pollen grains, the uninucleate condition had a frequency of 68%

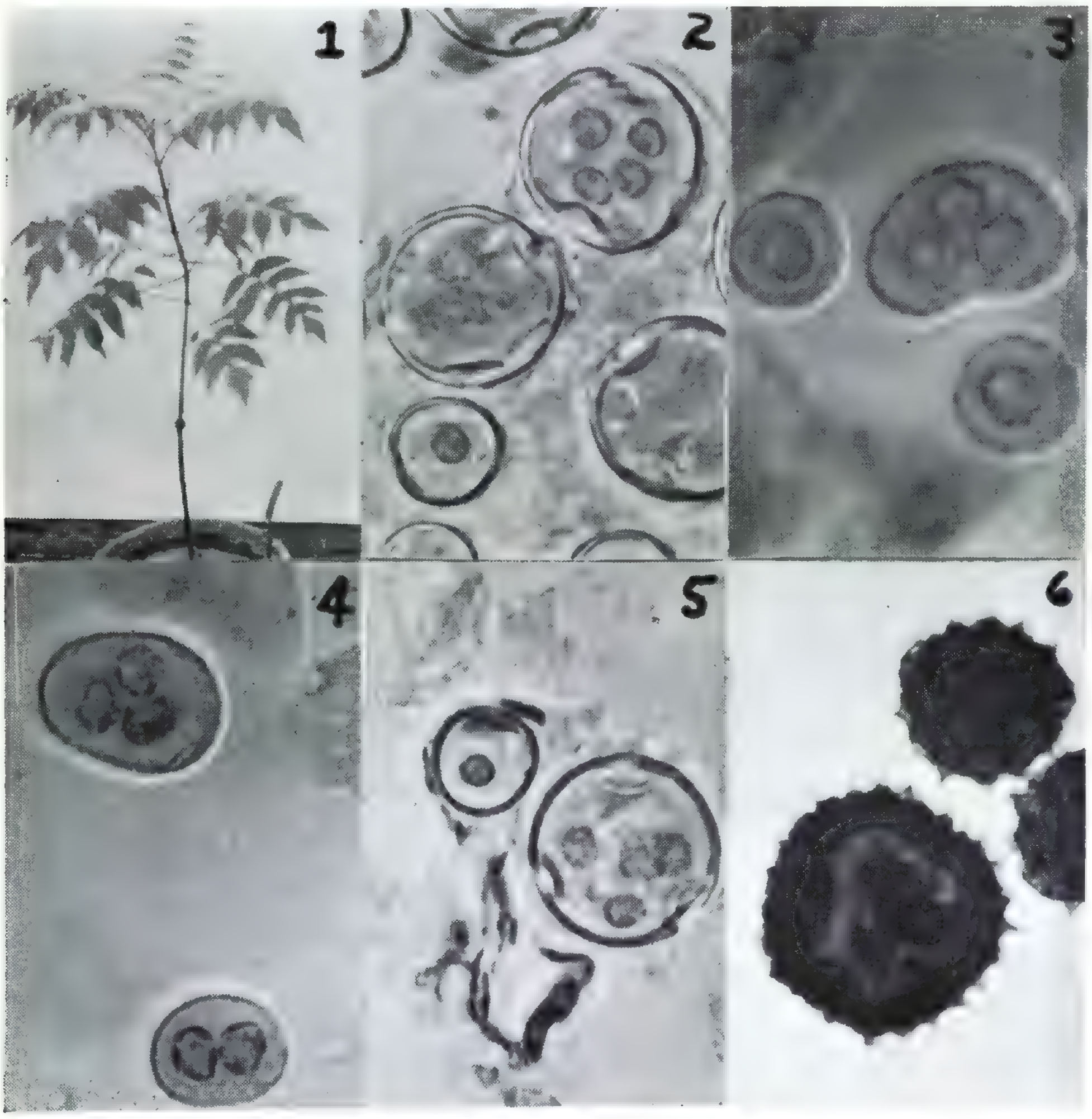

Plate 1273

Figures 1-6. Photographs of *Polymnia laevigata* showing plant and various pollen forms. Fig. 1. Immature plant. Figs. 2-5. Variable nuclear condition and morphologic forms of pollen. Fig. 6. Mature pollen, large and small spheres. Large spherical pollen grains in figures 2, 5, and 6 are 25μ in diameter; small uninucleate spherical forms are 15μ in diameter.

and the grains were about 15μ in diameter. This is the condition normally observed in other populations of this species. The trinucleate condition was the least observed condition, only 1.4% of the sample.

It is a common practice in taxonomic studies to use pollen stainability using aniline blue and lactophenol, as an index of pollen viability. Since this stain often obscures nuclear detail, rendering an exact count of nuclei uncertain, the pollen was grouped into two categories; namely, "large" and "small." The "large" group included quadrinucleate and trinucleate forms. The "small" group included the uninucleate and binucleate forms. There were a few instances in which the size of the pollen and its orientation made grouping difficult but familiarity with the material was thought to have avoided such miscalculation. The results of this treatment are shown in table 2.

From a random sample of 500 pollen grains, 77.5% fell into the "small" group and proved to be 94% stainable. The large pollen grains represented by 22.5% of the total sample were 88% stainable. In other words, the frequency of stainability among the smaller pollen grains was higher than for the larger. Ordinarily, when such a stainability test is applied to large and small pollen, the smaller pollen usually fails to become stained.

DISCUSSION

Dimorphic pollen has been reported previously. Lee (1961) in *Tripogandra grandiflora* observed two types of pollen from the same flower; namely, hemispherical, fertile grains and elongate, sterile grains. Erdtman (1952) noted two pollen shapes in two different plants of *Primula farinosa*. Punnett (1923) reported round pollen versus long pollen in different plants of *Lathryus odoratus*. Clark (1940) observed variation in the number of nuclei in pollen of *Zea mays*.

In *P. laevigata*, both anomalies are combined within the same plant: that is, variation in the number of nuclei and the shape of pollen grains. Moreover, there are not just 2 shapes of pollen (dimorphism) but 4 distinct shapes.

This assemblage of pollen forms coupled with variation in number of nuclei is termed "heteromorphic pollen." To the authors' knowledge, this term has not been used previously. No meiotic abnormalities were observed using the aceto-carmine squash technique. The gametic chromosome number is n = 15. First generation hybrids have been obtained involving *P. laevigata* and *P. canadensis* but only one hybrid resulted from 38 attempted crosses using this plant (Wells 254) as the pollen parent.

Two reasonable explanations can be proposed to account for this heteromorphic pollen. First, failure of wall formation at the completion of meiosis II would account for a pollen grain with four nuclei. Second, and we believe more plausible, an erratic precocious division of the microspore nucleus. This population of Tennessee plants will be revisited and an attempt made to secure more material for a thorough developmental study.

SUMMARY

One population representative of *P. laevigata* was found to contain 4 kinds of pollen grains in respect to number of nuclei and four kinds in respect to shape. If large and small spheres are considered separately, there are 5 kinds of pollen grains. The smaller sized pollen were uninucleate; the larger quadrinucleate. A term suggested for this type of pollen found on the same plant is "heteromorphic pollen." Although no explanation for this condition is known, two theories are proposed; namely, failure of wall formation at the termination of meiosis II and erratic precocious divisions of the microspore nucleus.

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Table 1. The number and frequency of nuclei per pollen grain from a random sample of 500 grains.

number		frequency
1	.....	340 (68%)
2	.....	58 (11.6%)
3	.....	7 (1.4%)
4	.....	95 (19%)
	Total	500 (100%)

Table 2. The stainability and frequency of small and large pollen from a random sample of 500 grains.

stainability		frequency
small pollen		
+ stain	.....	366 (94%)
— stain	.....	23 (6%)
	Total	389 (100%)
large pollen		
+ stain	.....	98 (88.3%)
— stain	.....	13 (11.7%)
	Total	111 (100%)

CHANGES IN FLORA OF THE MACHIAS SEAL ISLANDS

RADCLIFFE B. PIKE AND ALBION R. HODGDON[1] [2]

Machias Seal Islands, at the entrance to the Bay of Fundy, have occupied a prominent place in ornithological literature ever since 1603 when they were named Les Isles des Perroquets or the Parrot Islands by Champlain. A number of studies were made here by Audubon, and at the present time, a bird sanctuary is maintained by the United States Govern-

[1]This research is part of a project entitled "Floristic and Phytogeographic Investigation of the Wolf Islands and Other Islands in the Bay of Funly," which was supported in part by a grant from the Central University Research Fund of the Graduate School of the University of New Hampshire and in part by a grant from the Society of the Sigma Xi.

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[2]Department of Horticulture and Botany, University of New Hampshire, Durham, N. H.

ment. Observations of plant life on these islands, when made, seem to have been buried in ornithological writings or have gone unpublished, as practically nothing appears in botanical journals or records.

As part of a phytogeographic survey of Islands of the Bay of Fundy, a short visit was made by the senior author to the Machias Seal Islands on 29 August 1960. The islands are hardly more than ledges, with only the larger one having any real soil or obvious terrestrial vegetation other than lichens and a few halophytic plants of rock-crevices.

These islands lie about ten miles off Cutler, Maine, and can be reached by small boats when the "Bay" is reasonably calm. Botanizing is more pleasant after the nesting season is over and the birds have departed sometime in August. Only the larger island was visited, the smaller one, called Gull Rock, being practically inaccessible; however, observations were made from the boat with binoculars. No trees or evidence of any trees nor any woody plants of any sort occur on these islands, not even the matted or prostrate shrubs such as *Juniperus horizontalis*, *Empetrum nigrum*, or *Vaccinium Vitis-Idaea*. Herbaceous plants in great vigor, however, occupied every available niche in 1960. Asters in spectacular profusion, in full bloom at the time, dominated the flora of the island and were easily the most conspicuous element of the vegetation. Many of the plants stood breast-high and individual clones varied from six to twenty feet across. The flowers were mostly in shades of blue and violet with some plants varying to pinkish or nearly white. Sentinels of matured *Coelopleurum* and *Rumex obtusifolius* were scattered throughout, with clumps of yarrow, the foliage so gigantic as to be almost unrecognizable. Plants of *Iris versicolor* with leaves six feet tall were noted. The extraordinary vigor and lushness of the herbage doubtless was due to the continual rain of guano during the early growing season, combined with the high humidity of the Fundian atmosphere. The only other conspicuous kind of vegetation was the well-kept lawn near the lighthouse which, at the time of the visit, was carpeted with euphrasias in full flower. During the short stay on the island on August 29, a total

of 34 species was collected as shown in the accompanying list.

The following year, a chance clue led to an exchange of communication with Dr. R. T. Clausen, who called our attention to a record of collections and a survey made in the years 1947-48 by Oscar Hawksley (Bird-Banding XXVIII No. 2 April 1957) as part of an investigation of the nesting habits of the Arctic Tern. In two years, 41 species of plants were collected. Hawksley stated on page 4, "an attempt was made to collect all the species of vascular plants on the island." Since his list was remarkably different in many respects from our list of 1960, a further survey was made to reconcile the two. On September 17, 1962, therefore, the senior author, this time with two experienced assistants, carefully combed the island. At the same time, a complete sampling of the aster clones was made for a later population analysis.

Sixty-two species as well as other minor taxa were collected, a marked increase over either previous list, but twelve species of Hawksley's list were still missing. The obvious procedure at this point would be to carefully study Hawksley's herbarium specimens, which we were informed were deposited in the Wiegand Herbarium at Cornell University. Unfortunately, the Curator, Dr. Clausen, reports that these are missing or perhaps were not left there. Not wanting to postpone this paper indefinitely, we prefer to proceed with our discussion of the Machias Seal Islands now, and in the event that this collection does come to light, make any necessary corrections in the list at that time.

The most noteworthy fact about the Machias Seal Island flora is the remarkable difference over an eighteen year period, which may be explained by any of the following reasons. The lists may be imperfect, resulting from fragmentary collecting or collecting only at one season. On the other hand, weed species may have come and gone or new ones arrived recently on an island that is so much visited. The climatic factors of one year may provide different growing conditions from another. The effect of domestic animals may have been most drastic, particularly in earlier years.

The interaction of the plants and the usually heavy breeding population of birds may result in periodic fluctuations of dominance of certain plant species.

Hawksley lists twelve species that we have been unable to find, while we are reporting 36 species not found by him. Several of Hawksley's twelve are species that might be expected, *Carex brunnescens, C. silicea, Urtica dioica, Iris Hookeri, Rumex crispus, Lathyrus palustris,* and *Euphrasia canadensis,* for example. But it is to be noted that a specimen of *Urtica viridis* Rydb. collected by Mrs. A. H. Norton is present in the Herbarium of the New England Botanical Club. Certainly these two nettles might easily be confused. It is also of interest that A. H. Norton (Rhodora 15:138, 1913) in recording observations of *Iris Hookeri,* made the following comment: "this plant ..... abounds on most of the islands (excepting Machias Seal Island) east of Petit Manan Point." A particular search for this species was made both in 1960 and 1962, but without success. Of course, it may exist in a precarious state of balance with other more vigorous vegetation. *Rumex mexicanus* may easily be confused with *R. pallidus.* Our material in good fruit proves to be the latter. *Cerastium vulgatum* was collected on both recent visits and occurs there in some abundance, and it could be that *C. viscosum* was confused with it. Although similar in general appearance, the common plant of seacoasts and low marine islands is *Potentilla Egedei var. groenlandica* rather than *P. anserina. Coelopleurum lucidum,* when immature, might be confused with *Heracleum;* we have not seen it on other small islands in the Bay of Fundy where *Coelopleurum* is common. The much greater list of 1962 may be explained in part by the advantages of getting more species in maturity and at a time when birds did not interfere with collecting and with the growth and development of plants.

The phenomena of plant succession and vigor were closely observed by Hawksley as they seemed to have direct bearing on his population study of Artic terns. He noted a number of vegetational changes, some of the more violent of which were influenced by man and his domestic animals.

In 1944 there were 40 sheep on the island. In Hawksley's words (p. 85), "the vegetation ..... was close-cropped and much of it was destroyed completely." Recovery was apparent by 1946, and the following year the plant growth reached a height of 40 inches. A decline started in 1947 again with the aid of sheep (only four) and continued into 1949 with *Rumex Acetosella* and grasses replacing much yarrow.

Curiously enough, little mention is made of asters, which eleven and thirteen years later were the dominant herbage on much of the island. Even though asters would not have been in bloom during the months of Hawksley's visits, yet it would have been hardly possible to have ignored them when preparing a detailed vegetation map such as he made (Fig. 2, p. 63). He collected only one aster, and this species appears to be the minor one in the aster complex which was such a major feature in 1960 and 1962. One can only speculate as to what led to the appearance and rapid dominance of these asters.

Certain conclusions from this study bearing on island flora seem to be warranted. Even on a limited and isolated island, the composition of the flora under some conditions can apparently change to a considerable degree in a matter of only a few years. As a result of this work, one is led to wonder just what constitutes a definitive flora. The dynamics of floristic and vegetative change along with the uncertainty of making entirely complete collections show the danger involved in assuming a "flora" to be finished.

All specimens collected on the two visits in 1960 and 1962 are to be found in the Herbarium of the University of New Hampshire.

CONSOLIDATED FLORA OF MACHIAS SEAL ISLAND	HAWKSLEY 1947-48	PIKE 1960	PIKE 1962
Osmunda cinnamomea L.	X		X
Festuca rubra L. var. rubra	X		X
Puccinellia paupercula (Holm) Fern. & Weath. var. alaskana (Scribn. & Merr.) Fern. & Weath.			X
Poa annua L.		X	X
Agropyron repens (L.) Beauv. var. subulatum (Schreb.) Reichenb.	X		X

Agropyron repens var. subulatum forma Vaillantianum (Wulf. & Schreb.) Fern.			X
Agropyron repens var. subulatum forma setiferum Fern.			X
Elymus arenarius L. var. villosus Mey.	X		
Calamagrostis canadensis (Michx.) Nutt. var. canadensis			X
Calamagrostis canadensis var. robusta Vasey			X
Agrostis alba L.			X
Agrostis alba var. palustris (Huds.) Pers.	X	X	X
Phleum pratense L.	X		X
Carex canescens L. var. canescens			X
Carex brunnescens (Pers.) Poir.	X		
Carex scoparia Schkuhr			X
Carex silicea Olney	X		
Carex hormathodes Fern.		X	X
Carex paleacea Wahlenb.		X	X
Juncus bufonius L.		X	X
Juncus bufonius var. halophilus Buchenau & Fern.			X
Sisyrinchium montanum Greene	X		X
Iris Hookeri Penny	X		
Iris versicolor L.	X	X	X
Urtica viridis Rydb. collected by Mrs. A. H. Norton, July 27, 1902 (NEBC).			
Urtica dioica L.	X		
Rumex mexicanus Meisn.	X		
Rumex pallidus Bigel.		X	X
Rumex orbiculatus Gray		X	X
Rumex crispus L.	X		
Rumex Acetosella L.	X	X	X
Polygonum aviculare L. var. littorale (Link) W. D. J. Koch		X	X
Atriplex patula L. var. patula			X
Atriplex glabriuscula Edmondston		X	X
Spergularia marina (L.) Griseb. var. leiosperma (Kindb.) Gürke		X	X
Arenaria lateriflora L.	X	X	X
Stellaria media (L.) Cyrillo	X		X
Stellaria graminea L.			X
Cerastium vulgatum L.		X	X
Cerastium viscosum L.	X		
Ranunculus repens L. var. villosus Lamotte			X
Ranunculus acris L.	X	X	X
Thalictrum polygamum Muhl.		X	X
Capsella Bursa-pastoris (L.) Medic.	X		X
Sedum Rosea (L.) Scop.	X	X	X
Potentilla norvegica L.	X		X

Potentilla anserina L.	X		
Potentilla Egedei Wormsk. var. groenlandica (Tratt.) Polunin		X	X
Trifolium pratense L.	X		
Trifolium repens L.	X	X	X
Trifolium hybridum L.			X
Vicia augustifolia Reichard		X	X
Vicia Cracca L.		X	X
Lathyrus palustris L.	X		
Callitriche verna L.			X
Impatiens capensis Meerb.	X	X	X
Viola Mackloskii Lloyd subsp. pallens (Banks) Baker	X		X
Carum Carvi L.	X		X
Ligusticum scothicum L.	X	X	X
Coelopleurum lucidum (L.) Fern.		X	X
Heracleum maximum Bartr.	X		
Lycopus uniflorus Michx.		X	X
Euphrasia Randii Robins.			X
Euphrasia canadensis Townsend	X		
Euphrasia americana Wettst.		X	X
Rhinanthus Crista-galli L.	X	X	X
Plantago major L.	X		X
Plantago juncoides Lam. var. decipiens (Barneoud) Fern.	X		X
Galium tinctorium L.		X	X
Aster foliaceus L. (complex)		X	X
Aster johannensis Fern.	X	X	X
Aster umbellatus Mill.			X
Gnaphalium uliginosum L.			X
Achillea borealis Bong.			X
Achillea lanulosa Nutt.	X		X
Matricaria matricarioides (Less.) Porter	X		X
Cirsium arvense (L.) Scop.	X	X	X
Cirsium arvense forma albiflorum (Rand & Redf.) R. Hoffman		X	
Hypochoeris radicata L.	X		
Leontodon autumnalis L.			X
Taraxacum erythrospermum Andrz.	X		
Taraxacum officinale Weber		X	X
Sonchus asper (L.) Hill			X

THE FERNS AND FERN ALLIES OF CHIHUAHUA.[1]. — This attractively prepared volume merits special attention for it is the first comprehensive modern treatment of the rich pteridophyte flora of Mexico. The authors have both collected extensively in the state of Chihuahua, with the particular purpose of augmenting the previous collections and phytogeographic knowledge. Together, they have collected all but 18 of the species. They are to be congratulated on the thoroughness of their work and the accurate presentation of their results.

Although 120 species are known from Chihuahua, and an additional 6 from adjacent areas are treated, the authors recognize that the fern flora is still incompletely known. Additional species will be discovered as collecting continues in many less accessible areas, especially the isolated mesic barrancas of the western Sierra Madre Occidental. However, the basic explorations have been completed. The authors are to be commended in bringing out their work at this time so that it may fill a long-standing need.

The introduction surveys the collecting activities in the state of Chihuahua, the vegetation, geology, physiography, climate and the ecology and distribution of the pteridophytes. There is also a discussion of the typical structure and life-history of ferns, their cultivation and economic uses. A list of the known chromosome numbers of Chihuahuan species is a useful supplement. The principal text presents the pertinent nomenclature, a careful and complete description and the ecology and distribution of the 138 taxa recognized. Each species is illustrated; a number of them adequately for the first time. Keys are provided as an aid in identification and these, in combination with the excellent illustrations and the frequent discussions of characters make the book one of unusual utility. The appendix is devoted to comments on the species to be expected in Chihuahua, a

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[1]Ferns and Fern Allies of Chihuahua, Mexico, by Irving W. Knobloch and Donovan S. Correll (illustrated by Phoebejane Horning and Jane Roller) i-xiv, 1-198, t. 1-57. (Contrib. Texas Res. Found. vol 3) Texas Research Foundation, Renner, Texas. 1962. $10.00.

gazetteer, a glossary of terms, a bibliography and an index. The gazetteer will be useful to many botanists concerned with the location of often obscure place-names in Chihuahua.

From my own point of view, it is refreshing that the classification adopted is a highly realistic one. I refer particularly to the recognition of the *Polypodiaceae* in the broad sense, to the generic treatment of the Cheilanthoid ferns and to the use of the category variety (rather than species) for important but subordinate taxa. Such practice is a departure from the tendency of many authors to accept, uncritically, some of the more recent but unsubstantiated views on classification.

The pteridophyte flora of Chihuahua, as one expects, is primarily a xeric one. This is emphasized by the predominance of the genera characteristic of arid lands in the Americas. *Cheilanthes* is represented by 23 species, *Notholaena* by 15, *Selaginella* by 11 xeric ones and *Pellaea* by 9. The truly mesic element consists of about 12 species and it is confined to the barrancas of the Sierra Madre Occidental. This is a tropical element which mostly reaches its northwestern limit in Chihuahua. Representative species of this element are: *Dennstaedtia distenta*, *Trichomanes radicans*, *Hymenophyllum tunbridgense*, *Adiantum Poiretii*, *Thelypteris rudis* and *Dryopteris parallelogramma*. This book will be useful for a considerably larger area than the single state it covers. Fifty-nine of the species also occur in southern California, Arizona or New Mexico and 110 of them occur elsewhere in Mexico. Of these, 85 extend southward to central Mexico and 61 to southern Mexico or beyond. Eleven species are known in Mexico only from Chihuahua. Five of these are endemic and the remainder occur in the United States.

THE FERNS AND FERN ALLIES OF CHIHUAHUA is an authoritative treatment and it can be recommended to all botanists with an interest in ferns or with a broader interest in the flora of arid regions. It will also be an important reference for those concerned with any portion of the flora of Mexico or the southwestern United States. — ROLLA M. TRYON, GRAY HERBARIUM, HARVARD UNIVERSITY.

A Note on × Cyperus Weatherbianus — Early in 1962, Mr. Richard J. Eaton, a member of the Club Committee on Plant Distribution which is preparing reports on the distribution of Cyperaceae in New England, asked me while I was at the Gray Herbarium to examine the type of × *Cyperus Weatherbianus* Fern., a putative intergeneric hybrid between *Cyperus dentatus* Torr. and *Rhynchospora capitellata* (Michx.) Vahl. This plant had been puzzling me for a long time, for *Cyperus* and *Rhynchospora* belong to different tribes. Other cyperologists had some doubt too. For instance, in his monograph of the genus *Cyperus* (Pflanzenreich IV. **20**(Heft 101): 251. 1936) the late G. Kükenthal commented as follows:

"Nota. *C. Weatherbianus* Fernald in Rhodora XX. (1918) 190, t. CXXV, fig. 1-5 a cl. Fernald pro prole hybrida bigenerea, nempe *Cyperus dentatus* Torr. × *Rhynchospora capitellata* Vahl sumptus mihi dubius esse apparet, parentibus indicatis in systemate Cyperacearum admodum distantibus. Sed specimina originalia non vidi.

Crescit in Massachusetts: Sandy shore of Simmons Pond (C. A. Weatherby, Fernald und Long n. 16287)."

A close look at the type of × *Cyperus Weatherbianus* Fern. shows that this plant has very little, if any, *Cyperus* influence in its make-up. First, the stem is nodose, and the scales of the fascicled spikelets are three ranked. These two characters eliminate the genus *Cyperus*, which has only basal leaves and two-ranked spikelets. After studying all the possibilities, I am convinced that the plant is the result of a cross between *Rhynchospora capitellata* (Michx.) Vahl and *Dulichium arundinaceum* (L.) Britton, *Rhynchospora* having provided the three-ranked colored scales, whereas *Dulichium* contributed the shape and the distribution of the fascicles emerging from the leaf-sheaths of the stem, as well as the subulate tubercle of the achene.

This finding is of great phylogenetic importance, for the real position of the genus *Dulichium* in the family Cyperaceae is still a debatable point. Whereas Kükenthal (Bot. Jahrb. **75:** 485-488. 1952) placed it amongst the Rhynchosporoideae, Fernald (Gray's Manual of Botany, ed. 8. 248) squeezed it between *Cyperus* and *Eleocharis*, and Schultze-Motel (Willdenowia **2**(2): 173. 1959) created a new tribe, Dulichieae, to accommodate this unusual monotypic genus.

This new evidence shows that *Dulichium* rightly belongs to the Rhynchosporoideae. It is strange that the late Professor Fernald after having originally described his intergeneric hybrid in 1918 with the scales spirally arranged, changed his mind in 1950 and in the *Gray's Manual* stated clearly, "the spikelets with many distichous scales." They are decidedly three ranked.

I do not think it necessary to transfer × *Cyperus Weatherbianus* to any other genus, for only one tussock has been found, that from Cape Cod. It is sufficient that we assume the probable correct identity of this odd individual and emphasize its phylogenetic importance. It is a chance, sterile, intergeneric hybrid that will probably never duplicate itself, so the problem of giving it a distinct name does not arise. — Marcel Raymond, Montreal Botanical Garden.

AN ALBINO FRUITED FORM OF VACCINIUM MACROCARPON. — A colony of albino berried plants was found on the west shore of Tom Nevers Pond, Nantucket Island, Massachusetts, on September 11, 1958. Two sets of specimens were collected of this plant, which were assigned the collection number N2. Because of the difficulty of getting into the area, and due to a previous coronary, I have never returned to it. The small colony extended from the shore into a large area covered with plants bearing very dark red berries of large size. The albino berries were about three quarters of the size of the red berries. The set of fruit was about equal. There was a definite contrast between the plants due to the lighter foliage and the white berries of the albino plants. Thus, from high ground, these plants appeared to be massed in such a way as to resemble a slice of pie, the apex being furthest from the shore. The albino berries were nearly spherical, whereas the red berries were decidedly oblong. A few of the larger and older berries had a tendency to form "a blush" on their surfaces which were more exposed to the sun.

When I was certain that this was definitely a colony of albinos, I envisioned marketing the red and white berries

packaged together. An eye pleasing and picturesque product, to say the least. However, sauce made from the berries was of an amber color, insipid, and much like the flavor of a sour blackberry. (And — I know how to make a delicious cranberry sauce!)

On August 31, 1962 I had the good fortune to find another colony of these albinos. Some of the fruits were almost pure white but the majority were of a pale, cream color. The fruits on the uppermost portions of the plants, unlike those found previously, rarely showed any signs of a "blush." The prominent remains of the calyces were persistent on the somewhat constricted blossom ends of the berries — not fugacious as in most cranberries. Specimens from this colony will be distributed under my collection number N695.

This white berried plant is an albino fruited form of *Vaccinium macrocarpon* Aiton, and it should not be confused with the white berried *V. oxycoccos* L., forma *leucocarpum* Ascherson and Magnus.

Vaccinium macrocarpon Aiton, forma **eburnea** MacKeever. Differt ab planta typica in fructis eburneis. This form is similar to the species except for its albino fruits. The type specimen, N2, was collected by *Frank C. MacKeever*, at Tom Nevers Pond, Nantucket Island, Mass., on September 11, 1958, and is deposited in the herbarium of the New York Botanical Garden. An isotype is in the herbarium of the Museum of Natural Science, Nantucket, Mass. — FRANK C. MACKEEVER, NEW YORK BOTANICAL GARDEN.

JUNIPERUS HORIZONTALIS IN NEW HAMPSHIRE.

A colony of this plant occurs at Holt's Ledge in Lyme, Grafton County. This was called to our attention by Professor James Poole of Dartmouth College with whom we had the pleasure of visiting the area on June 23, 1959. Professor Poole does not know who discovered this colony. He collected specimens from it at the time of his first visit to the station on October 21, 1937, but he informs us that there are records of collections by earlier botany classes as far back as 1930. On our June, 1959, visit we were able to find the juniper again after brief searching.

Only 2 small mats of it were seen; neither one more than

3 or 4 feet across, and each probably consisting of only a single plant. They were growing on shelves near the crest of the high and steep ledge. It is possible that there were other remnants of this meager colony farther down on more inaccessible shelves of the ledge, but we were satisfied, for the time being at least, to find these small plants. This colony has more than passing interest because, aside from the well known station on Mt. Equinox in southwestern Vermont, it is the only known inland station in New England, but unlike the Vermont locality there seemed to be no calcareous rock in the Holt's Ledge area, nor any plants present that might be thought of as of calcareous affinity.

Specimens have been deposited in the Herbaria of the University of New Hampshire, Dartmouth College and the New England Botanical Club.

This is the first verified record of this plant from New Hampshire. Bean, Hill and Eaton (Rhodora 63: 348) correctly excluded it from the state on the basis of the then available published information. — A. R. Hodgdon and F. L. Steele, university of new hampshire, durham and st. mary's-in-the-mountains, littleton, new hampshire.

CYPERUS FERRUGINESCENS IN VERMONT. In early September, 1961, I collected a *Cyperus* on the grassy shore of the Connecticut River in Vernon, Vermont, at the southeast corner of the state. Subsequently I referred it to *C. ferruginescens* Boeckl. This species is rare in New England and hitherto known in New England only from three riparian stations near Hartford, Connecticut. There were no specimens in the Club Herbarium (N.E.B.C.) and only four sheets in the Gray Herbarium. My collection, *Eaton 5088*, at Vernon, Windham County, Vermont, September 7, 1961, represents a significant extension of range, northward. Mr. F. C. Seymour and Dr. Marcel Raymond have kindly examined it and concur in the determination. It has been placed in the herbarium of the New England Botanical Club.

There is some question whether *C. ferruginescens* deserves

specific rank or is better treated as a variety of *C. odoratus* L. In New England it seems distinct morphologically as well as in respect to range and habitat preference. Here it appears to be confined to alluvial soils well removed from salt water, whereas *C. odoratus* is generally found in saline or brackish situations, and only along the coast as far northeastward as Essex County, Massachusetts. Elsewhere in North America the former is conspicuously inland in its distribution, whereas the latter is primarily coastal as far west as the mouth of the Mississippi River. There is some overlap in range northward along the edges of the Mississippi River valley and particularly beyond its western side (South Dakota, Nebraska, Oklahoma, Texas, and thence westward to Southern California). Furthermore, *C. odoratus* is semi-cosmopolitan (North and South America, eastern Asia), whereas *C. ferruginescens* is confined, I believe, to North America. Unless close study has demonstrated the existence of intergrading forms in the areas of overlap, it seems better to maintain them as separate species. RICHARD J. EATON, LINCOLN, MASSACHUSETTS.

AN UNUSUAL RUBUS. The subgenus *Eubatus* of the genus *Rubus* contains such a variable assemblage of entities that it is not unusual to find a plant that cannot be identified. However, the blackberry to be described in this note presents some unusual features. On July 21, 1961 in the town of Altamount, New York, I found a *Rubus* with an unusual inflorescence in an old field near the edge of a bog. The flowers were small, about the size of a blossom of *R. hispidus*, but many were of a type often referred to as "double", with 10-15 petals of various sizes, apparently representing altered stamens. This plant did not fit any blackberry described in Gray's Manual, Eighth Edition, but seemed to fall in the section Tholiformes, and in the key came closest to the group that included *R. biformispinus*, *R. grandidens* and *R. arcuans*. However, it differed from all of these plants in several ways. It seemed more probable that it was of hybrid origin.

In an effort to determine the putative parents, eight samples of primocanes and floricanes were collected and growth habit notes made for each one individually. Later various measurements were made. The following characteristics were noted: growth habit from trailing to doming to erect up to 2½′; armature consisting of stiff prickles, acicular prickles, bristles and glands, length of longest prickle up to 5 mm., number of all types of armature combined from 200 to 800 per dm.; primocane leaflets uniformly dull, subcoriaceous, length from 5.5 to 7.0 cm., number of leaflets ranging from 3 to 5, ratio of width to length from .65 to .8, broadest part of leaf at the middle or well above the middle; inflorescence resembling *R. hispidus* or *R. setosus*.

On the basis of these characters it was not possible to form a positive conclusion as to the origin of the blackberry. The leaflet shape and number seemed to be derived from *R. hispidus*, the armature from *R. elegantulus* and *R. setosus*. Other characters could have come from one or more of these three species, all of which were in the vicinity. Extensive field observations have convinced me that these species hybridize frequently.

A specimen of this blackberry has been deposted in the Herbarium of the University of New Hampshire.

FREDERICK L. STEELE, ST. MARY'S-IN-THE-MOUNTAINS, LITTLETON, NEW HAMPSHIRE.

WESTERN PLAINS PLANTS IN NORTHERN ILLINOIS[1] — A number of western plants are established on a gravel bluff prairie, known locally as Bell Bowl prairie, in southern Winnebago County, in Greater Rockford Airport a few miles south of Rockford, Illinois. They can be divided into two groups.

One group is composed of annual or perennial plants that are being spread by seed and are found over the county and over the state. Among them are such more or less common species as *Agropyron smithii* Rydb., *Froelichia gracilis* Moq., *Solanum rostratum* Dunal, *Artemisia dracunculoides* Pursh

[1]Contribution of the Evelyn I. Fernald Memorial Herbarium of Rockford College.

and *Ratibida columnifera* (Nutt.) Wooton & Standl. They are now widespread and their presence here does not require any special comment.

The other group is made up of the following perennials which have a number of peculiarities in common. *Poa arachnifera* Torr. is found elsewhere in the county in connection with highway shoulder seeding (Fell, 1955) but on Bell Bowl prairie it does not have the appearance of having been planted nor of spreading except by stolons. *Buchloë dactyloides* (Nutt.) Engelm. (buffalo grass) is reported by Jones (1958) as having been collected recently by V. H. Chase in Peoria County 110 miles south of us. In Bell Bowl it occurs in several patches each about 10 feet in diameter. It is spreading by stolons. *Chloris verticillata* Nutt. (windmill grass) is credited to the same collector from the same area by Jones & Fuller (1955). With us it grows in a number of patches none of which is more than two feet in diameter. It produces viable seed abundantly but does not seem to be spreading by this means. *Carex praegracilis* W. Boott and *C. stenophylla* Wahl. var. *enervis* (C. A. Mey.) Kükenth. (*C. eleocharis* Bailey) have been previously commented upon (Fell, 1958). They produce seed sparingly and seem to reproduce only vegetatively. *Schrankia nuttallii* (DC.) Standl. (sensitive briar) was collected by Francis McDonald in the Peoria area in 1903 according to Jones & Fuller (l.c.). On Bell Bowl prairie it produces flowers but no seeds were found.

None of the above plants are recorded otherwise than as mentioned from Illinois so the presence of all of them here in a small area, a gravel bluff one half mile long, is a matter of interest. This is particularly true because of their absence from the numerous other prairie patches in the county that furnish the same type of habitat (Fell and Fell, 1956), dry gravel hills or bluffs exposed to the prevailing westerly winds, which are from the north in winter and from the south in summer. If they are natives they are relics of dying populations. This is suggested somewhat by their poor reproduction by seed. It seems unlikely that all these plants could have been growing in this vicinity a hundred years ago and some of them not have been found by so active a

collector as M. S. Bebb. Another possible explanation of their being here is the fact that this area was within Camp Grant during World War I and this particular tract was an important remount station and trench warfare training center. The numerous horses and mules were shipped here from the west of the Mississippi River as was also hay and straw in bales for use as bedding and in making ramparts for the trenches and effigies for bayonet practice. These shipments may have served as transports for the seed of these plains plants. The ones that reproduce readily by seed here have become disseminated, the others have stayed where they were originally introduced. — EGBERT W. FELL.[2]

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[2]Dr. Egbert W. Fell died on July 16, 1960.

ADDITIONS TO THE FLORA OF ILLINOIS. — Field and herbarium studies in Illinois continue to add to the number of species known from that State. As has been the situation for the past six or seven years, many of the additions are native species rather than adventives or incidental waifs.

All specimens cited are deposited in SIU, except that of *Agrimonia microcarpa* which is in MO.

Paspalum lentiferum Lam. A large colony of this southern grass occurs in a semi-swampy roadside ditch near Karnak in Pulaski County. Considerable similarity exists between this species and the southeastern *P. boscianum*. The stramineous fruit distinguishes *P. lentiferum*. The fact that the southern Illinois station is several hundred miles from the nearest known station would seem to indicate an adventive status for this species, although the marshy situation simulates its natural habitat.

Pulaski Co.: low roadside ditch, near Karnak, *S. Boyce s.n.*

Rhynchospora macrostachya Torr. This giant horned rush, which closely resembles *R. corniculata* and under which name it was distributed, has its only station in a swamp north of Pulaski in Pulaski County. The long bristles which greatly exceed the achenes readily distinguish this species from *R. corniculata.* The nearest station to the Illinois locality is in southern Missouri. Some of our specimens attain a height of nearly one meter. *Rhynchospora corniculata* is usually a taller species in Illinois.

Pulaski Co.: north of Pulaski, July 12, 1955, *R. Mohlenbrock and J. Voigt 5542.*

Carex nigromarginata Schwein. This species belongs to the difficult § Montanae, which is represented in Illinois by seven species. Of these, *Carex emmonsii, C. physorhyncha,* and the present species have been found within the last four years. *Carex nigromarginata,* because of its partially hidden spikelets and its persistent, shreddy leaves, is very similar to *C. umbellata* and *C. abdita.* It is distinguished by its much narrower perigynia.

Union Co.: cherty soil, Pine Hills, *W. Ashby & R. Kelting s.n.*

Cydonia oblonga L. The quince is an Asiatic shrub which rarely escapes from cultivation. On the top of Atwood Ridge in Union County occur two shrubs of this species along a trail. Although no other indication is evident of previous habitation, the area must have been the site of an old homestead. The finding of these shrubs in an otherwise wild area is surprising.

Union Co.: along trail, Atwood Ridge, May 27, 1957, *Steyermark, Voigt, & Mohlenbrock s.n.*

Agrimonia microcarpa Wallr. A collection of this species (labeled *A. platycarpa*) from near Cahokia in the latter part of the nineteenth century is the sole record of this species from Illinois. This specimen apparently has been overlooked in the past. The Illinois station marks the northwest limit of the range of this species. It closely resembles *A. parviflora,* but is distinguished by its smaller fruits (up to 3 mm long) and its fewer leaflets (5).

St. Clair Co.: near Cahokia, in 1877, *H. Eggert s.n.* (MO).

Polygala sanguinea L. f. *albiflora* (Wheelock) Millsp. The white-flowered form of the common *Polygala sanguinea* occurs in a rather large colony in a railroad prairie near Elkville. The "typical" form is abundant in the same area.

Jackson Co.: railroad prairie, one-fourth mile south of Elkville along Route 51, July 2, 1962, *G. Folkerts s.n.*

Euphorbia dictyosperma Fisch. & Mey. This western species was found on a limestone ledge at the edge of a hill prairie near Fults in Monroe County. Only a few specimens were observed. The beautiful, intricately reticulated fruit distinguishes this species from the similar *E. obtusata.*

Monroe Co.: limestone ledge, near Fults, *J. Ozment s.n.*

Vaccinium stamineum L. This species has been sought in southern

Illinois for several years since it is known from Indiana and Missouri. It finally has been found on a xeric sandstone bluff at Hayes Creek Canyon, where it occurs with the very abundant *Vaccinium arboreum*. The senior author was attracted to the two shrubs of *V. stamineum* because of the much paler color of the foliage. Our specimens, with the branchlets and leaves glabrous, belong to var. *neglectum* (Small) Deam.

Pope Co.: sandstone blufftop, Hayes Creek Canyon, May 19, 1962, *R. Mohlenbrock 14914*.

Infrequently Collected Southern Illinois Plants

Phragmites communis Trin. The most southern records of this species in Illinois previously are from St. Clair County (*Eggert* in 1877) and Effingham County (*Voigt* in 1960). These stations are over one hundred miles from the locality reported here. At this Franklin County station, a huge colony exists.

Franklin Co.: around pond, near Christopher, August 1, 1962, *C. Bollwinkel & J. Richardson s.n.*

Poa palustris L. A collection of this primarily northern species from a low woodland in the Pine Hills of Union County marks the first record from southern Illinois. The nearest station is in Fulton County, over two hundred miles distant.

Union Co.: low woodland, Pine Hills, August, 1961, *W. Ashby & R. Kelting s.n.*

Potentilla millegrana Engelm. This species, which is distinguished from *P. norvegica* var. *monspeliensis* by possessing 10-15 stamens, has been found in a disturbed woods in Jackson County. The only previous record of this species from Illinois is a collection (*H. Eggert* in 1877) from National Stockyards, St. Clair County.

Jackson Co.: open woods, Thompson's Woods, Carbondale, August 3, 1962, *G. Folkerts s.n.*

Tragia cordata Michx. This semi-twining plant had been collected twice on the banks of the Ohio River at Golconda, Pope County, by S. A. Forbes and E. J. Palmer. Now Hardin County can be added to its distribution.

Hardin Co.: limestone bluff, near Shetlerville, *J. Ozment s.n.* — Robert H. Mohlenbrock, James E. Ozment & George W. Folkerts, southern illinois university, carbondale.

Nostoc parmelioides in Massachusetts — Studies of the algae of Worcester County are few, the most recent being those of Auyang (1) and the author (6). Particular interest is aroused, therefore, when a rather erratically occurring alga (3) is located in the county.

In September, 1961 Dr. Burton Gates of Clark University

collected growths of *Nostoc* from granite rocks in Keyes Brook, East Princeton, Mass. While instructing in the summer session at Clark, I became interested in learning more about this alga, for it appeared to be restricted to this habitat and location. The water temperature at several collecting trips was 22° to 23° C., and the pH a constant 8.3. Exposure ranged from full sun to partial shade. Specimens were sent to Mr. William Daily (2), and the alga was determined to be *Nostoc parmelioides* Kuetz.

Tilden (5) records collections of this alga made between 1851 and 1898 from five states, Connecticut, Pennsylvania, Wyoming, Nevada, New York, and from Canada.

Drouet (3) considers it to have "a peculiar distribution in North America." He has records of it from the following stations: Connecticut (Goshen, 1895; Mt. Carmel, 1891; Hamden, 1932; Quinebaug River, 1893), Quebec in 1930, New Jersey (Delaware River, 1941; Saxton Falls, 1953, 1958), Indiana in 1934, Nebraska in 1948, and then numerous locations from the Rocky Mountains westward.

Fralick (4) at the Farlow Herbarium has seven collections of this species from Connecticut, Wisconsin, and further west.

The collections by Gates in 1961, then, appear to be a first for this species not only in Worcester County, but also in Massachusetts.

Several trips to East Princeton were made by the author in July, 1962, and specimens of *Nostoc parmelioides* are on deposit at the following institutions: Academy of Natural Sciences, Philadelphia, Pa., Butler University, Indianapolis, Ind., Cornell University, Ithaca, N. Y., Dartmouth College, Hanover, N. H., Farlow Herbarium, Harvard, Cambridge, Mass., Michigan State University, E. Lansing, Mich., University of Massachusetts, Amherst, Mass. — EDGAR E. WEBBER, DEPARTMENT OF BOTANY, UNIVERSITY OF MASSACHUSETTS, AMHERST.

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Errata for Rhodora Volume 64

p. 33. Caption to Fig. 1.
Transpose *Rorippa nasturtium — aquaticum* and *R. microphylla*
p. 40 line 38, for DOMINICA read DOMINICAN REPUBLIC
p. 172 *Carex plantagianea* read *Carex plantaginea*
p. 173 line 45, *C. striata* read *C. stricta*
p. 175 line 44, *C. laevigata* read *C. laevivaginata*
p. 177 line 9, *C. Sprengellii* read *C. Sprengelii*
p. 177 line 27, *C. chordorhiza* read *C. chordorrhiza*
p. 177 line 28, *C. crinita* var. *brevirostris* read *C. crinita* var. *brevicrinis*

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